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Report of the Arctic Fisheries Scientific Advisory Committee for 1986/87 and 1987/88

R. McV. Clarke, L. Johnson, G.D. Koshinsky,
A.W. Mansfield, R.W. Moshenko and T.A. Shortt

Central and Arctic Region
Department of Fisheries and Oceans
Winnipeg, Manitoba R3T 2N6

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June 1989

REPORT OF THE ARCTIC FISHERIES SCIENTIFIC ADVISORY COMMITTEE FOR 1986/87 AND 1987/88

by

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TABLE OF CONTENTS

	Page
ABSTRACT/RÉSUMÉ	iv
OVERVIEW OF THE ARCTIC FISHERIES SCIENTIFIC ADVISORY COMMITTEE: 1986/87 AND 1987/88	1
Introduction	1
The Role of the Arctic Fisheries Scientific Advisory Committee	2
AFSAC membership	2
AFSAC activities	3
General results	3
General conclusions	3
REPORT OF THE AFSAC FISH SUBCOMMITTEE: 1986/87	4
Review of general background documents	4
Lake trout of Great Bear Lake	6
The walleye of Mosquito Creek	7
The walleye utilizing Hay River	8
The walleye from Tathlina Lake	9
The walleye from Kakisa Lake	10
Sea-run Arctic charr of the Central Arctic and Baffin Island	11
REPORT OF THE AFSAC FISH SUBCOMMITTEE: 1987/88	13
Coregonids of the Mackenzie Delta	14
The Lake trout of Great Bear Lake	15
The walleye of Mosquito Creek	16
Arctic charr in the Firth River	17
Arctic charr in the Babbage River	18
Arctic charr in the Rat River	19
Arctic charr in the Big Fish River	20
Arctic charr in the Hornaday River	21
Arctic charr in the Kuuk River	22
Arctic charr in Freshwater Creek	23
Arctic charr of Steensby Inlet	24
Commercial quotas for anadromous Arctic charr	28
REPORT OF THE AFSAC MARINE MAMMALS SUBCOMMITTEE: 1986/87	28
High Arctic narwhal	28
Sub-Arctic walrus	29
Western Hudson Bay beluga	30
Southeast Baffin beluga	30
REPORT OF THE AFSAC MARINE MAMMALS SUBCOMMITTEE: 1987/88	31
Eastern Beaufort Sea beluga	31
Northern Hudson Bay narwhal	33
Ringed seals	34
ACKNOWLEDGMENTS	35

LIST OF TABLES

Table		Page
1	The numbers of situations for which scientific advice is required by fishery category and by type of advice	36
2	Schedule proposed in 1986 for AFSAC reviews for 1986/87 to1989/90 and preparation of background documents	37
3	Creel census summary from Mosquito Creek, 1973-1986	40
4	1986/87 quotas and production and 1987/88 recommended quota for the anadromous Arctic charr commercial fisheries in the Northwest Territories	41
5	Commercial harvest of Arctic charr from the Hornaday River between 1977 and 1986	52
6	1987/88 quotas and production and 1988/89 recommended quotas for the anadromous Arctic charr commercial fisheries in the Northwest Territories	53

LIST OF APPENDICES

Appendix		Page
1	Central and Arctic Region. Arctic Fisheries Scientific Advisory Committee. Terms of Reference and Operating Procedures, April 1987	66
2	List of AFSAC Background Documents for 1986/87 and 1997/88	68

ABSTRACT

Clarke, R. McV., L. Johnson, G.D. Koshinsky, A.W. Mansfield, R.W. Moshenko, and T.A. Shortt. 1989. Report of the Arctic Fisheries Scientific Advisory Committee for 1986/87 and 1987/88. Can. Manuscr. Rep. Fish. Aquat. Sci. 2015: iv + 68 p.

The Arctic Fisheries Scientific Advisory Committee (AFSAC) was established in November 1985 to develop and provide scientifically sound advice for stocks of fish and marine mammals in the Northwest Territories, the north slope of the Yukon and territorial waters that are managed by the Central and Arctic Region. AFSAC comprises a Chairperson, Executive Committee, Fish Subcommittee and Marine Mammals Subcommittee, operates on the peer review principle, reports to the Director, Biological Sciences, and advises the Regional Director General and Regional Director, Fisheries and Habitat Management. In 1986/87 and 1987/88, AFSAC reviewed and developed advice on three general topics, twelve specific fish stocks, three complexes of fish stocks, annual commercial quotas for Arctic charr, six specific marine mammal stocks and one marine mammal species. AFSAC concludes that, in general, the management of these stocks of fish and marine mammals is scientifically sound given the current limits of knowledge and understanding. AFSAC encourages the Region's management to continue to find ways to obtain the required data and develop required management goals and models so that the management of stocks can improve.

Key words: Arctic zone; fish; management; marine mammals; research programmes; stocks.

RÉSUMÉ

Clarke, R. McV., L. Johnson, G.D. Koshinsky, A.W. Mansfield, R.W. Moshenko, and T.A. Shortt. 1989. Report of the Arctic Fisheries Scientific Advisory Committee for 1986/87 and 1987/88. Can. Manuscr. Rep. Fish. Aquat. Sci. 2015: iv + 68 p.

Le Comité scientifique consultatif des pêches canadiennes dans l'Arctique (CSCPCA) a été créé en novembre 1985 dans le but d'étudier de manière rigoureusement scientifique les stocks de poissons et de mammifères marins des Territoires du Nord-Ouest, du versant nord du Yukon et des eaux territoriales gérées par la Région du Centre et de l'Arctique. Le CSCPCA est composé d'un président, d'un comité exécutif, d'un sous-comité des poissons et d'un sous-comité des mammifères marins; il fonctionne selon le principe de révision par les pairs, rend compte de ses activités au Directeur des Sciences biologiques et conseille le Directeur général régional, le Directeur régional du service de Gestion des pêches et de l'habitat. En 1986-1987 et en 1987-1988, le CSCPCA a examiné trois sujets d'intérêt général, douze stocks de poissons, trois complexes stocks de poissons, six stocks de mammifères marins, une espèce de mammifère marin ainsi que sur les quotas commerciaux annuels de l'omble de espèce de mammifère marin ainsi que sur les quotas commerciaux annuels de l'omble de l'Arctique, et fait des recommendations à leur égard. Le CSCPCA conclut que de manière générale et compte tenu de l'état actuel des connaissances, ces stocks de poissons et de mammifères marins sont gérés de manière rigoureusement scientifique. Le CSCPCA encourage les gestionnaires de la Région à perfectionner les méthodes de collecte des données et à établir les objectifs et les modèles de gestion nécessaires à l'amélioration de la gestion des stocks.

Mots-clés: zone de l'Arctique; poisson; gestion; mammifères marins; programmes de recherche; stocks.

OVERVIEW OF THE ARCTIC FISHERIES SCIENTIFIC ADVISORY COMMITTEE: 1986/87 AND 1987/88

INTRODUCTION

The Central and Arctic Region of the Department of Fisheries and Oceans (DFO) manages and protects the fishery resources of the Northwest Territories (NWT), the north slope of the Yukon, the tidal waters of Manitoba and Ontario, and with two exceptions, the offshore territorial waters. Fishery management in coastal marine waters bordering northern Quebec in James Bay, Hudson Bay and Hudson Strait has been assigned to the Quebec Region of DFO. Fisheries in offshore waters of Davis Strait and the eastern portion of Hudson Strait (NAFO areas 0B and 2G north of 60°N) are managed in conjunction with the Northwest Atlantic Fisheries Organization (NAFO) and the Newfoundland Region of DFO.

The Northwest Territories and the north slope of the Yukon contain about 36% of Canada's land and 18% of its fresh waters. The Arctic coastline comprises 71% (172 979 km) of Canada's coastline. The total marine area is about 3.2 million km^2 or about 67% of Canada's coastal waters. The land is sparsely populated by some 50 000 people with equal proportions of Indian and Metis, Inuit, and people of other ethnic origins.

The harvesting of fish and marine mammals has always been a dominant human activity in the Canadian Arctic. Fish and marine mammal resources serve several functions in the social, cultural and economic life of northerners, particularly Indians, Metis and Inuit. Domestic (=subsistence) and recreational (=sport) harvesting occurs in all areas where people live or travel. Commercial fisheries occur in waters of Davis Strait and Baffin Bay, some coastal rivers and a few lakes such as Great Slave Lake.

Northern residents increasingly are looking towards fishery resources to provide food, cultural experiences and recreation for a growing population. They also wish to diversify their economic base through the development of new commercial fisheries and the sale of fish products between northern communities and to the south.

Beluga (Delphinapterus leucas), narwhal (Monodon monoceros), bowhead whale (Balaena mysticetus), walrus (Odobenus rosmarus) and seals occur in the eastern Arctic and Hudson Bay. Beluga, bowhead whale and seals also occur in the western Arctic. Commercial whaling, which began about 1600 and continued until 1969, has had a major effect. Bowhead was the main quarry although there was some harvesting of beluga, narwhal, walrus and seals. Now, in Canada all stocks of these species are harvested in domestic hunts, except for the bowhead whale which is recognized as being an endangered species. In 1984/85 about 500 beluga, 300 narwhal, 400 walrus, 37 000 ringed seal (Phoca hispida), 2 000 harp seal (Phoca groenlandica) and 2 000 other seals (bearded seal (Erignathus barbatus), harbour seal (Phoca vitulina), and hooded seal (Cystophora constata) were taken in the domestic hunts. Several of the stocks are also harvested off northern Quebec and in Alaskan and Greenland waters. As a result of historical commercial whaling, the bowhead stocks and the eastern Hudson Bay, Ungava Bay and southeast Baffin beluga stocks are reduced in numbers. The walrus is reduced in range and probably numbers, and the harbour seal is reduced in range and numbers. In contrast, no evidence exists that hunting has affected the numbers or range of other beluga stocks, narwhal stocks or other species of seals, nor is there evidence that these stocks and species are being harvested at levels which cannot be sustained. However, only the ringed seal appears to have potential for supporting an increased harvest.

Important freshwater and anadromous fish resources occur throughout the Canadian Arctic. Anadromous Arctic charr (Salvelinus alpinus) is important along the Arctic coasts, and anadromous whitefishes and ciscoes (Coregonus spp.) occur in the lower Mackenzie River and along the Beaufort Sea coast. Whitefish, ciscoes and lake trout (Salvelinus namaycush) occur throughout the inland area and are especially important in the Mackenzie Valley and Mackenzie Delta. Northern pike (Esox lucius) and walleye (Stizostedion vitreum) are important in some inland areas as are Arctic grayling (Thymallus arcticus), inconnu (Stenodus leucichthys) and burbot (Lota lota). These species support various domestic, commercial and recreational fisheries. In 1984/85 about 350 tonnes of Arctic charr and 950 tonnes of other freshwater and anadromous fish were taken in domestic fisheries. That year, about 1 300 tonnes of these species were taken commercially for export from the territories by 122 people, and had a landed value of $1 700 000 and a market value of $3 000 000. The Great Slave Lake fishery provided 93% of the commercial landings (lake whitefish (Coregonus clupeaformis), northern pike, inconnu, lake trout and walleye) and 75% of the landed value. The Cambridge Bay and Rankin Inlet Arctic charr fisheries provided 4% of the landings and 21% of the landed value. Also in 1985, about 172 692 angler-days were recorded, including 51 957 by non-residents, by 16 907 licensed anglers and 3 922 children. Anglers spent $15 574 537 in the NWT. The main species taken were lake trout, walleye, northern pike, Arctic grayling and Arctic charr. About 304 tonnes of fish were retained. The whitefishes of the Mackenzie Delta are, perhaps, the only major under-exploited Arctic freshwater fish resource, but some Arctic charr stocks and other small, remote fish stocks may be under-exploited.

Marine fish and shellfish are of less direct importance in the NWT at present, although species such as Arctic cod (Boreogadus saida) and capelin (Mallotus villosus) are major links in the Arctic marine food chain. Several species are harvested commercially in the Davis Strait-Hudson Strait area, primarily by southern Canadian and foreign fishermen. In 1985, NAFO established total allowable catches of 28 300 tonnes for Atlantic cod (Gadus morhua) and 9 000 tonnes for redfish (Sebastes spp.) in the Green-

land part of these waters, and 25 000 tonnes for Greenland halibut (Reinhardtius hippoglossoides), 8 000 tonnes for roundnose grenadier (Coryphaenoides rupestris) and 36 000 tonnes for shrimp (Pandalus montagui and P. borealis) in the Canadian plus Greenland waters. Residents of the NWT currently are expressing more interest in commercial harvesting of these resources especially cod, Greenland halibut, shrimp and Iceland scallops (Chlamys islandicus) in the Davis Strait-Hudson Strait area, capelin in Hudson Bay and Pacific herring (Clupea harengus) in the Beaufort Sea. These and other marine fish, such as flounders and other species of cod, invertebrates, such as clams, mussels and starfish, and marine plants, such as kelp, are also harvested for local consumption.

THE ROLE OF THE ARCTIC FISHERIES SCIENTIFIC ADVISORY COMMITTEE

One part of the process for the management of these important fish and marine mammal resources is ensuring that scientifically sound advice is provided to those responsible for making fishery management decisions. Consequently, the Region established the Arctic Fisheries Scientific Advisory Committee (AFSAC) in November, 1985, to develop and provide this advice.

AFSAC was established, under the direction of the Director of Biological Sciences, to be an internal DFO committee which will enable the Central and Arctic Region to provide biologically sound advice to fishery management boards, to demonstrate the biological soundness of the Region's fishery management decisions to other resource users, industry and government agencies, to assess the biological basis for these decisions and to ensure all advice is subject to peer review of its scientific quality. The availability of biologically sound advice would result in increased DFO effectiveness in consultations with clients. AFSAC's objective is:

> to provide sound biological advice to Fisheries Management (the Director General and Regional Director of Fisheries and Habitat Management of the Central and Arctic Region) on Arctic fish and marine mammal stocks so that management decisions result in the long-term well-being of these stocks.

Its specific responsibilities are:

a) to assess the status of fish and marine mammal stocks and to make biologically sound recommendations on harvest levels;
b) to assess other biological aspects of management (such as size restrictions, closed seasons, mesh size, etc.) and to make biologically sound recommendations on such operational requirements for management;
c) to assess the adequacy of biological information available for making fisheries management decisions and to make recommendations for its extension or improvement;
d) to review and assess biological aspects of general management plans for fish and marine mammals; and
e) to respond to any other requests for biological advice on fisheries management and habitat issues from the Director General, Regional Director of Fisheries and Habitat Management, Regional Director of Science, or Director of Biological Sciences, Central and Arctic Region, as may from time to time arise.

In short, it is AFSAC's job to make sure that all available data, whether they are from harvest monitoring, stock assessment, research or experimental management, are used and that the data are interpreted to provide the best possible scientific advice to the Region's fishery managers.

AFSAC's original terms of reference were modified in April 1987 to reflect Departmental reorganization; these are provided in Appendix 1.

Because of the geographical overlap of responsibilities within DFO and the migratory nature of several fish and marine mammal species, other jurisdictions (e.g. Quebec Region, Greenland/Denmark, Alaska/USA) or review processes (e.g. Canadian Atlantic Fisheries Scientific Advisory Committee) are involved in the development of scientific advice.

AFSAC MEMBERSHIP

AFSAC discharges its responsibilities through the activities of its Chairperson, Executive Committee, Fish Subcommittee and Marine Mammals Subcommittee. The majority of members are from the Central and Arctic Region. Quebec Region was represented on all committees, and members also came from Pacific Region and Scotia-Fundy Region. In 1986/87 and 1987/88 AFSAC's membership was:

Chairperson and
Executive Committee:

L. Johnson	(Science, Central and Arctic Region) AFSAC Chairperson, 1986/87; Fish Subcommittee Chairperson
G. Koshinsky	(Science, Central and Arctic Region) AFSAC Chairperson, 1987-/88
R. Clarke	(Pacific and Freshwater Fisheries (P&FF), Central and Arctic Region)
A. Mansfield	(Science, Quebec Region) 1987/88 only
R. Moshenko	(P&FF, Central and Arctic Region) Marine Mammals Subcommittee Chairperson

Fish Subcommittee:

L. Johnson	(Science, Central and Arctic Region) Chairperson
J. Craig	(Science, Central and Arctic Region)
R. Crawford	(Science, Central and Arctic Region) 1986/87 only
M. Healey	(Science, Pacific Region) 1986/87 only
C. Hudon	(Science, Quebec Region) 1987/88 only
A. Kristofferson	(P&FF, Central and Arctic Region)
A. Mansfield	(Science, Quebec Region) 1986/87 only
J. Reist	(Science, Central and Arctic Region) 1987/88 only

Marine Mammals Subcommittee:

R. Moshenko	(P&FF, Central and Arctic Region) Chairperson
P. Brodie	(Science, Scotia-Fundy Region) 1986/87 only
M. Kingsley	(Science, Central and Arctic Region)
A. Mansfield	(Science, Quebec Region) 1986/87 only
P. Richard	(P&FF, Central and Arctic Region)
T. Smith	(Science, Quebec Region) 1987/88 only
R. Stewart	(Science, Central and Arctic Region)

AFSAC ACTIVITIES

AFSAC formally began its work with the inaugural meeting of the Executive Committee on 2 May 1986. It reviewed and finalized its draft Terms of Reference and Operating Procedures, which then were approved by the Director of Biological Sciences.

AFSAC identified that scientific advice was required for the management of about 250 or more fish stocks and about 25 or more marine mammal stocks (Table 1). For these, AFSAC, in consultation with the Regional Director, Fisheries and Habitat Management, and the Director of Biological Sciences, identified a program for reviews from 1986/87 to 1989/90 (Table 2).

To aid its work, AFSAC commissions the preparation of background documents on specific topics; these are internal documents solely for the use of AFSAC.

For 1986/87, AFSAC commissioned the preparation of three general papers, five reports on fish stocks and three reports on marine mammal stocks (Appendix 2). These AFSAC documents were reviewed at the joint meeting of the Fish Subcommittee and the Marine Mammals Subcommittee in Winnipeg on 21-22 January 1987. After that meeting, the subcommittees continued their reviews of these documents and developed their recommendations. An urgent review of the Mosquito Creek walleye stock was requested by the Regional Director, Fisheries and Habitat Management. This was undertaken by the Fish Subcommittee at a meeting on 29 January 1987. Also, an urgent review of Steensby Inlet Arctic charr was conducted in May, 1987.

For 1987/88, AFSAC commissioned the preparation of eleven reports on fish stocks and four reports on marine mammal stocks (Appendix 2). The reports on fish stocks were reviewed at the 15-16 February 1988 meeting of the Fish Subcommittee. The reports on marine mammal stocks were reviewed at the 28-29 January 1988 meeting of the Marine Mammals Subcommittee.

GENERAL RESULTS

The main results of AFSAC's activities in 1986/87 and 1987/88 were the development of management recommendations and the identification of research requirements for 12 fish stocks, three fish stock complexes, commercial quotas for anadromous Arctic charr, six marine mammal stocks and one marine mammal species.

To aid the presentation of the background information and recommendations for each stock, a common reporting format was developed which was used for most reviews. The basic format is:

- Background
  - Stock definition
  - Stock size
  - Vital parameters
  - Current harvest
  - Other impacts
- Major issues
- Assessment
  - Stock prognosis
- Management recommendations
- Research requirements
- Next AFSAC review

The specific recommendations from each review are contained in the reports of the Fish Subcommittee for 1986/87 and 1987/88, and of the Marine Mammals Subcommittee for 1986/87 and 1987/88; these constitute the four major sections of this report. They include summaries of the information presented and AFSAC's advice on the stocks considered. The Fish Subcommittee's 1986/87 report also includes the reviews of the three general background papers.

GENERAL CONCLUSIONS

The reviews identified some problems common to the management of many of the fish and marine mammal stocks. The problems primarily result from the size of the area, the scattered nature of the resource, different stocks having very different management problems, and a data base which needs expansion. Some general requirements identified include:

- better harvest statistics (e.g. species, numbers, size, date, location, biological samples), especially for domestic fisheries;

- collection of long-term data series so that techniques, such as cohort analysis, can be applied to the management of stocks;
- development, testing and application of models appropriate for the management of Arctic fish and marine mammal stocks; and
- continued improvement of data on stock identity (especially for coregonids in the Mackenzie Delta), stock size and vital parameters of stocks.

The Region's managers are aware of these problems, and AFSAC encourages them to continue to find solutions so that the required data and models become available to improve the management of fish and marine mammal stocks.

Despite the current shortcomings, AFSAC concluded that, in general, the management of these stocks of fish and marine mammals is as scientifically sound as possible. AFSAC's management recommendations generally are either an endorsement or fine-tuning of present or proposed management approaches.

Procedurally, 1986/87 and 1987/88 have been a learning and developmental period for AFSAC. Generally, AFSAC has operated soundly. However, a major problem has been the lack of timeliness in delivering AFSAC's advice developed at the annual meetings of its subcommittees. Remedial steps to correct this problem were implemented for 1988/89. In contrast, advice from AFSAC in response to urgent requests was developed and delivered quickly.

Finally, the authors of the AFSAC background documents are encouraged by AFSAC to publish them as technical reports, or as other publications, as soon as possible.

REPORT OF THE AFSAC FISH SUBCOMMITTEE: 1986/87

The AFSAC Fish Subcommittee met on 21-22 January 1987, to review the current status of designated fish stocks, to examine the possible effects of past and current management practices on these stocks and to evaluate the probable effects of proposed management changes. At the meeting, the Subcommittee also reviewed the proposed 1987/88 commercial quotas for anadromous Arctic charr.

The following three general background documents requested by AFSAC were reviewed by the Subcommittee:

Limnology, Oceanography and Fisheries Research: The View from the Arctic Window. L. Johnson. (AFSAC Document 86/87-4)

Exploitation of Arctic Fishes. R. Crawford. (AFSAC Document 86/87-3)

Studies on the Systematics and Population Structure of Arctic Marine, Anadromous and Freshwater Fishes. A Justification and Statement of Need for Research. J. Reist. (AFSAC Document 86/87-2)

The Subcommittee also reviewed the following five documents on fish stocks requested by AFSAC:

Status of the Lake Trout of Great Bear Lake, NWT. G. Yaremchuk and M.M. Roberge. (AFSAC Document 86/87-5)

Status of the Walleye Utilizing the Hay River, Northwest Territories. M.M. Roberge and G. Low. (AFSAC Document 86/87-6)

Status of the Walleye Stock from Tathlina Lake, Northwest Territories.M.M. Roberge and G. Low. (AFSAC Document 86/87-7)

Status of the Walleye from Kakisa Lake, Northwest Territories.M.M. Roberge and G. Low. (AFSAC Document 86/87-8)

Status Report on Sea-run Arctic Charr of the Central Arctic and Baffin Island. A. Kristofferson, G. Low, L. Dahlke, E. Gyselman and L. Johnson. (AFSAC Document 86/87-10)

The Subcommittee undertook an urgent review of the Mosquito Creek walleye stocks at a meeting on 29 January 1987. This was in response to a request by the Regional Director, Fisheries and Habitat Management.

The background document reviewed was:

Status of the Walleye Stock Utilizing Mosquito Creek, Northwest Territories. M.M. Roberge and G. Low. (AFSAC Document 86/87-9).

The membership of the Fish Subcommittee for 1986/87 was:

L. Johnson	(Science, Central and Arctic Region) Chairperson
J. Craig	(Science, Central and Arctic Region)
R. Crawford	(Science, Central and Arctic Region)
M. Healey	(Science, Pacific Region)
A. Kristofferson	(P&FF, Central and Arctic Region)
A. Mansfield	(Science, Quebec Region)

The Subcommittee thanks all those involved in the preparation of the above documents for their untiring efforts. It recommends, and urges strongly, that these documents be prepared for publication as Canadian Fisheries and Aquatic Sciences Manuscript Reports, or other suitable publication, if and when appropriate.

The following sections review the background documents, and provide a statement of the conclusions and recommendations of the Fish Subcommittee.

REVIEW OF GENERAL BACKGROUND DOCUMENTS

Three reports were requested by AFSAC to provide part of the necessary scientific background for the development of fishery management programs for the Arctic. They encompass three levels of approach which, taken together, provide an overview of the biological, social and commercial factors governing the Arctic fishing

industry, and the natural constraints imposed upon it, as well as suggestions for improving the scientific basis of fishery management.

Limnology, oceanography and fisheries research

This paper provides a general theoretical framework for understanding fish production processes at the world level. It is argued that, not only is fisheries research in the Arctic important within the confines of the Arctic region, but has great implications with respect to the rest of the world. The importance of Arctic research is stressed because of the simplicity of Arctic aquatic ecosystems, their absence of disturbance since formation, and their high degree of autonomy. In these factors they differ from the vast majority of other systems in the world.

Given these attributes, a generalized Arctic aquatic ecosystem can be regarded as a reference system against which other systems may be compared. Only in such a system can various environmental and biological factors be isolated and investigated. For example, the effect of interspecific competition among fishes can be eliminated, as certain lakes contain a single species only. Thus the proposition is advanced that the proper place to begin aquatic research is in the Arctic. This broad view has implications for biology in general and not merely for fisheries or aquatic research.

With the Arctic lake as a point of departure, it is possible to construct various series of lakes of increasing diversity of fish species or increasing productivity, as well as series that assist in the elucidation of the perplexing notion of "stability." Lakes isolate the effect of local climate, in a manner that is not possible in the oceans. From the Arctic to the tropics, it is thus possible to examine a range of local systems in lakes that may be compared with the much more open conditions of the oceans. In this manner a conception of the web of factors influencing production can be built up. Conversely, examining conditions in the oceans at equivalent latitudes to specific lakes or rivers, provides feedback in the understanding of lake processes. These and other matters are explained by differences in energy flow constraints. This concept of energy flow as the basis for production provides new insight into Arctic productive systems. Without this insight management objectives may be unrealistic.

The exploitation of Arctic fishes

The second paper discusses in broad outline the historical importance of Arctic fisheries to the indigenous people, the problems and advantages of exploiting Arctic fishes, various types of fishery involved and the changing pattern of utilization.

In the days of the Pre-Dorset, Dorset and Thule cultures, the marine and freshwater fishes were little used and largely unknown. Truly marine and freshwater fishes are difficult to catch without sophisticated modern technology, and, as a result, greatest dependence was placed on the anadromous species, such as Arctic charr. Arctic charr were captured in large numbers in stone weirs or "saputits", during the return migration from the sea. Only relatively small rivers could be exploited in this way.

The fisheries existing today are based mainly on anadromous or lacustrine resources; such marine stocks as exist have remained largely unexploited.

Fisheries in the Arctic can be divided into three competing types: domestic fisheries for local consumption, commercial fisheries in which the fish are exported to southern markets, and recreational fisheries, both for local residents and for non-resident fishermen. Of these fisheries, DFO gives the domestic fishery allocational precedence, giving Inuit and Indian fishermen priority in usage, when fishing for their own needs.

The major commercial fisheries, Great Slave Lake, the Mackenzie Delta, Cambridge Bay and the west coast of Hudson Bay, are each examined in some detail. The first two fisheries are primarily for whitefish: in Great Slave Lake, lake whitefish is the preferred species, but in the Mackenzie Delta it is the broad whitefish, Coregonus nasus. Cambridge Bay and Hudson Bay fisheries are dependent on anadromous Arctic charr. The problems of management of these diverse types of fishery are discussed with particular emphasis on the employment of innovative management techniques. Management problems are compounded by the existence of competing recreational and domestic fisheries.

A great increase in recreational fishing in the NWT is documented by the increase in licences issued: 5 586 in 1968/69 versus 16 061 in 1985.

The only marine fishery of any significance was established for Atlantic cod at Port Burwell/Killinek. However, in recent times, the disappearance of this cod has necessitated closure of the fishery.

The report then examines the potential for development of marine fisheries, species by species. While there are certain areas of potential, the Arctic usually has high initial concentrations of organisms (shrimp, scallops, etc.), but very low productivity with which to maintain these stocks.

The report concludes with a summary of the principal changes in the domestic, recreational and commercial fisheries in the NWT in recent years.

There is little information to support the general impression that the replacement of dog teams by snow machines has reduced domestic fishing. The reduction in fishing for dog food appears to have been offset by a greater demand for local food by an increasing human population.

The contribution of the NWT to the total Canadian commercial fishery is about 3%. NWT catches are now about 50% of the peak contribution in 1950. The most readily exploitable stocks now appear to be exploited to their natural limits. There appear to be few opportunities for increasing production of marine stocks, although there is some potential for Greenland halibut, shrimp and scallop. In all cases exploitation will demand a high level of technology and involve significant transportation costs. There has been a significant increase in the recreational fishery, largely owing to an increase in the resident human population. However, since 1980, recreational catches of lake trout, northern pike, Arctic grayling and Arctic charr have declined, while only walleye catches have increased.

Studies on the systematics and population structure of Arctic marine, anadromous and freshwater fishes

The third document emphasizes the need for the proper definition of fish stocks and knowledge of stock structure if satisfactory management is to be achieved. The complexity of stock structure is outlined. Without proper stock identification and information on the patterns of movement and intermixing of stocks, scientific management is exceedingly difficult. The report emphasizes that the results of research frequently reveal the great complexity of the real biological situation. This does not necessarily simplify the task of the manager, but it should at least inculcate a cautious approach in managers, users and researchers and allay any attempt to apply overly simplistic solutions.

The second part of the document outlines a program of research designed to meet the management need for stock identification, and at the same time it provides for a broad attack on systematic and distributional problems. Particular emphasis is given to "problem" or taxonomically difficult species, such as Arctic charr, broad whitefish and lake whitefish.

LAKE TROUT OF GREAT BEAR LAKE

Background

Great Bear Lake (37 000 km^2) is the largest body of freshwater within Canada. Since the lake first became relatively accessible in the years following World War II, its fishery has been managed for the domestic use of the residents of Fort Franklin, and for recreational fishing. No commercial fishery has ever been permitted except for a limited fishery to supply the needs of villages downstream. The domestic fishery is largely dependent on the lake whitefish and lake cisco (Coregonus artedii) stocks of the shallower waters of the bays and inlets. The recreational fishery depends on the relatively abundant population of large lake trout which is essentially the only species in the open waters of the lake. The first sport fishing lodges were established in the late 1950's, growing to the present number of five during the following decade.

The first biological survey of the lake was carried out in 1946, before any significant fishing activity had occurred beyond the limited domestic fishery and some local recreational fishing around the Port Radium uranium mine. A further biological survey and tagging program was carried out between 1963-1965 when interest in recreational fishing was increasing rapidly. Together, these surveys provide valuable data on the essentially virgin state of the stocks against which it is possible to interpret subsequent changes.

Stock definition: The lake trout population within Great Bear Lake is highly autonomous as there is no significant migration into or out of the lake. From tagging studies carried out over many years, it is apparent also that there is little movement of individual fish between the five main arms of the lake. For the purposes of management these five arms may be regarded as each harbouring a separate stock.

Stock size: There is no direct information on stock size. In the early years of the fishery, large lake trout were abundant, but it is evident that exploitation by angling alone has considerably reduced the frequency with which these large fish are caught. Following this early decline in abundance of the largest fish, there is no evidence to indicate that there has been a decline in the abundance of fish of modal size (between 600-700 mm, depending on location) in the past ten years. Changes in the policy of the lodges with respect to fish retained appear to have stabilized the population with respect to size and age structure.

Vital parameters: The most significant features of the lake trout population are the slow growth, great mean age and large average size. Individual fish probably reach 60 years of age, a length of over 1 000 mm, and a weight of 30 kg. A fish, 800 mm in length when tagged in 1965, was recovered over 20 yr later having grown only 200 mm in the interval. Tag returns from the 1965 operation continue to be made (1987). Many have shown extremely slow growth rates.

Natural mortality is estimated to be in the range of 0.08 to 0.12 and total mortality among fully recruited year classes is in the vicinity of 0.17 to 0.20. These low rates corroborate the very slow rate of turnover in the population.

Current harvest: Current harvest is restricted to one "trophy" fish per angler (approximately 700 fish per year) plus an equivalent amount in smaller fish for "shore lunches." This makes a total of approximately 10 000 kg per year.

The domestic catch at the time of the initial biological survey in 1945 was estimated to be about 725 000 kg, mostly lake whitefish and lake cisco. Fishing in Keith Arm in the vicinity of Fort Franklin continued for much of the year but the majority of the fish were taken in a fall fishery at the southern end of McVicar Arm. This fishery appears to have declined in

recent years, most activity now taking place in the vicinity of Fort Franklin. A rough estimate indicates that about 200 000 kg are now caught annually, the difference being due to the decline in the dog population and the consequent decline in the need for dog food.

Other impacts: There are no other impacts as far as is known. The only possible local source of environmental degradation is the mine at Port Radium.

Major issues

There are indications that the present recreational fishery for lake trout is not yielding the same number of large fish as formerly. It is possible that, despite apparent stabilization of length and age structure, the present level of exploitation is not sustainable. If so, changes in the regulations or general policy are probably required.

Assessment

There is little direct evidence of a recent decline in stocks. Modal size has remained relatively stable over a number of years. However, there is evidence from Arctic charr and other lake trout stocks in the NWT that modal sizes and modal ages change very little prior to a sudden decline. Of particular importance in this regard is the history of lake trout in the Western Arm of Great Slave Lake. Lake trout harvest in virtually every area showed little decline in mean weight during the first years of the fishery, but eventually a sudden reduction in mean weight was experienced. In due course, the lake trout were brought close to elimination in the Western Arm. It must be recognized that determining the age of such old fish involves a considerable margin of error that must be taken into account when assessments are being attempted. If ages are underestimated, mortality rates will be too high. Selection by anglers of the largest fish for retention also introduces considerable bias into the results, as does the expansion of the fishery into previously unexploited regions, in the search for fish of "trophy" size.

In Great Bear Lake the fishery certainly appears to be relatively stable under the present fishing regime, but this can only be verified by correct information on changes in stock density, information very difficult to obtain. On the face of things there is little apparent cause for change in regulations, but vigilance must be exercised.

Management recommendations

1. No further expansion of the fishery should be allowed in the areas now used extensively by anglers. This precludes the construction of additional lodges. The possible exception is the construction of one additional lodge in Keith Arm.
2. No commercial fishing should be permitted in the Arms in which fishing lodges have been established.
3. Lodge operators should maintain the harvest of lake trout below trophy size at the minimum level possible.

Research requirements

1. Continued monitoring of the various lake trout stocks at intervals of less than five years is needed. This is essential if the fishery is to be regulated properly and maintained at a satisfactory level.
2. Some relative measure of actual stock abundance should be obtained by examining changes in catch per unit effort.

THE WALLEYE OF MOSQUITO CREEK

Background

Mosquito Creek is situated at the north end of Great Slave Lake, close to the communities of Rae and Edzo. Each year during May and June walleye from the North Arm of Great Slave Lake move into the creek to spawn. Spawning migration upstream beyond the Mackenzie Highway is blocked by the culverts carrying the highway over the creek. These culverts cause a fall of 1-2 m, which the walleye are unable to negotiate. Fishing this spring spawning run is a major recreational activity in Yellowknife at this season. The number of anglers has increased and stocks appear to be declining, although the proportion of large, old fish has increased. The decline is a matter of considerable local concern for it suggests that there is quite severe over-fishing. Any change in regulations would be important to the population of Yellowknife. There is a domestic fishery on Mosquito Creek carried out by the people of Rae and Edzo, but the extent of this fishery is not known.

Stock definition: The spring run of walleye in Mosquito Creek represents an unknown fraction of the spawning population in the North Arm of Great Slave Lake. Tag returns indicate that, following the run, the surviving fish move out into the lake, becoming widely dispersed throughout the region. No other spawning runs have been identified in this general area of Great Slave Lake.

Stock size: Data were collected from anglers' catches between 1973 and 1986, and from a counting fence erected in the lower reaches of the river in 1974, 1975, 1978 and 1986.

Counts of fish passing upstream through the weir indicated a population of 5 600 spawners in 1975. In 1986, a total of 2 773 walleye passed upstream through the weir and 1 365 returned downstream. If the difference between these numbers (1 408) reflects the number caught by anglers above the weir, it represents a crude exploitation rate of 51%. However, 2 049 walleye were actually caught by angling . This indicates that the figure for exploitation is valid within reasonable limits.

In 1986, during the upstream run, 193 tags were applied. This represents 6% of the run.

During the post-spawning downstream migration, 40 tagged fish, or 3% of the run were recovered. Theoretically, the proportion of tagged fish in the downstream run should remain the same. Sixteen tags were recovered from anglers; therefore 115 tags were not recovered.

Vital parameters: The length-frequency distribution of the catch indicates relatively little change over the years; this is not unexpected in a spawning population. However, the age-frequency distribution in 1986 indicates an overall trend toward increasing age within the anglers' catch and a decline in the number of spawners in younger age groups. Modal age in 1986 was 14 yr as opposed to 12 yr in 1976.

There is great variation in the proportion of females in the catch, varying from a low of 3% in 1975 to a high of 58% in 1986. This may be the result of a differential pattern of movement between males and females, since females move onto the spawning grounds before the males arrive. Alternatively, it may be an indication of a fundamental imbalance within the population.

Current harvest: The angling catch from 1973 to 1986 is summarized in Table 3. A domestic fishery exists on this run, but there is no information on its extent. However the effect is considered to be small.

Major issues

It is evident that the harvest has increased greatly since records were first kept in 1973. There has been a concomitant increase in the number of angler hours although there is little evidence of a decline in catch per unit effort. However, evidence from the weir indicates a decline in total population.

Evaluation

The Subcommittee recognizes that the data are not as detailed as might be desirable, but that this desirable state is never achieved in any fishery investigation. It is therefore essential to make the most use of the information available.

It is the general perception of many fishery biologists that a decline in abundance of a fish stock as a result of heavy fishing, is reflected in a reduction in mean size and mean age of the catch. This generalization has not withstood the test of experience in many northern fish populations. Typically, these populations show little change in age or length-frequency distribution until there is a dramatic "flip" to a reduced size and age structure, indicating (after the fact) that far too great a rate of exploitation has been imposed on the population. Thus the search for indicators of over-exploitation has proved rather elusive in most populations of Arctic charr, lake whitefish and lake trout. The same may be true of walleye, although relatively little comparable information is available. Where data do exist, as in Kakisa and Tathlina lakes, the difficulties of interpretation are equally great.

Returns from the weir counts and the creel census indicate that a heavy fishing mortality is imposed on the Mosquito Creek stock. It would seem unlikely that a spawning population composed of such relatively old individuals would be capable of withstanding a fishing mortality of 50%. Furthermore, these figures do not include those fish caught downstream from the weir as they return to Great Slave Lake, or those fish subsequently caught in the domestic and commercial fisheries. The commercial fishery for walleye in Great Slave Lake and Marion Lake has intensified greatly in recent years because of price increases.

The consensus of the Subcommittee was that although the evidence for population decline is meagre in most areas, it is sufficient to justify a reduction in catch as a precautionary measure. Too often, populations have suffered collapse because there was insufficient direct evidence to warrant closing or reducing a fishery. In such circumstances discussions frequently continue until it is too late to effect useful changes in the regulations.

In view of the great value of this fishery to the residents of Yellowknife and the residents of Rae/Edzo, and the fact that the walleye commercial fishery in the North Arm is probably dependent on the spawning success of this stock, every effort should be made to ensure continuity of production. This can only be achieved if a conservative approach is taken.

Management recommendations

1. The catch limit should be reduced to three and the possession limit to five.
2. The length of the fishing season should be reduced by opening the fishery from 00:01 h to 24:00 h three times each week.

Research requirements

1. An annual creel census should be conducted to provide the necessary data for such adjustments in catch as may be deemed desirable in the interests of conservation.
2. The scope of the census should be increased to include fishermen below the weir.
3. A reassessment of the stock is needed in five years time.
4. A survey of the North Arm of Great Slave Lake should be conducted to search for and identify other walleye stocks.

THE WALLEYE UTILIZING HAY RIVER

Background

Walleye form an important recreational fishery for the inhabitants of the town of Hay River, situated on the shore of Great Slave Lake at the mouth of the Hay River. Recreational fishing takes place throughout the open-water period from June to October.

Stock definition: It is difficult on the available evidence, to define this stock with any degree of precision. The stock would appear

to form part of the walleye complex in Great Slave Lake, although apparently this is not a spawning run; individuals in the catch are in a state of non-maturity (either immature or with unripe gonads).

Stock size: There is no direct information on stock size. Fishing intensity in Hay River increased considerably between 1975 (when the first surveys were carried out) and 1986 (the time of the most recent survey). Over this period the catch per unit effort declined by 30%.

Vital parameters: The mean length of the catch increased from 338 to 365 mm between 1975 and 1985. Over this same period the mean age increased from 5 to 7 yr.

Current harvest: Harvest has increased from 2 120 walleye in 1975, through 2 484 in 1978 to 3 155 in 1986. Over this period catch per unit effort declined from 1.2 to 0.8 walleye per angler hour.

Other impacts: The main fishing area is close to the town site. These waters probably suffer minor disturbances resulting from town activities, but these are not likely to have any significant effect on the fishery.

Major issues

The major issue is whether the data available justify a change in angling regulations. This fishery is an important recreational outlet for the people of Hay River and is therefore a sensitive issue. There is a natural disinclination on the part of the local people to have further restrictions imposed on the fishery, yet a further decline in catch per unit effort would be regarded as due to DFO not having taken action in time.

Assessment

The shortage of relevant data and the apparent internal conflicts in those which do exist make a satisfactory evaluation of the fishery extremely difficult. The increase in mean size and mean age indicate that recruitment is inadequate to meet the need of stock replacement. Since no information is available on spawning and pre-recruit phases the causes of this inadequacy cannot be evaluated.

Management recommendations

1. The present catch and possession limits should be maintained.

Research requirements

1. A creel census should be conducted at three-year intervals.
2. A biological sampling program should accompany the creel census, to determine spawning sites, size, age and age at first maturity.
3. A tagging program is needed in association with the creel census to determine movement patterns.

THE WALLEYE FROM TATHLINA LAKE

Background

Tathlina Lake is situated on the Kakisa River, a tributary of Great Slave Lake. With Kakisa Lake, Tathlina Lake forms the most important fishery for walleye in the Northwest Territories; together, the two lakes contribute some 74% of the total annual commercial production of 40 000 kg. However, production in both Tathlina and Kakisa lakes is extremely variable from year to year. In Tathlina Lake there is some indication that production is cyclic.

The surface area is 57 000 ha, but the lake itself is extremely shallow (mean depth 1.5 m; maximum depth 3 m). Wave action maintains the water in a state of high turbidity. The shallowness of the lake appears to result in occasional partial winterkill, giving rise to the observed fluctuation in harvest levels. In such circumstances the intensity of winterkill depends on mean winter temperature, water level and snowfall; snowfall inhibits light penetration, thus controlling oxygen production. The intensity of winterkill is therefore not possible to predict. There is no information on winter limnological conditions.

The commercial fishery was established on Tathlina Lake in 1954 and has been in operation each year since then.

Stock definition: The walleye stock is apparently confined to Tathlina Lake with no significant movement of fish into or out of other areas. Fish tagged in Tathlina Lake have never been recovered from Kakisa Lake. Spring spawning runs are known to occur in the Kakisa River upstream from Tathlina Lake.

Walleye are assumed to be widely distributed throughout the lake during the summer, but appear to be concentrated in and near the mouth of the upper Kakisa River in winter.

Stock size: In the absence of direct observations, relevant information on stock size can be gleaned from production figures. When the commercial fishery began in 1954, regulations imposed a quota of 91 000 kg, and a minimum allowable mesh size of 114 mm (4.5 in). Although the quota was never actually taken (the highest catch was 55 181 kg in 1962), these regulations remained in effect until 1967 when the quota was reduced to 30 900 kg (= 0.5 kg/ha). The minimum allowable mesh size remained unchanged until 1980 when it was reduced from 114 to 108 mm (4.25 in), although no change was made in the quota. The quota of 30 900 kg has remained in effect until the present time.

Vital parameters: Mean lengths of the walleye from the commercial fishery from 1975 to 1986 ranged from 379 mm to 411 mm. There was a noticeable increase in the proportion of fish <350 mm in 1980, and an increase of fish in the length interval 410-450 mm in 1986. Mean age from 1975 to 1986 ranged from 7.9 yr to 10.9 yr. There has been a noticeable shift in the age distribution since 1975 toward fish older

than 11 yr and a concurrent decrease in fish 7 yr and younger. The modal length has increased from 380-389 mm in 1975 to 400-429 mm in 1986; modal age has increased from 8 yr in 1975 to 11 yr in 1986. Over this same period total instantaneous mortality ranged from 0.90 to 1.83. There appears to have been a decrease in natural mortality since 1983.

In the interval between 1946, when the first biological survey of Tathlina Lake was carried out, and 1979, modal length changed from 220-225 mm to 340-449 mm. In 1946 there were no mature fish in the 2-5 yr age groups. In 1979 the age of first maturity appeared to have increased as no mature fish younger than 6 yr were encountered; in that year maturity was not complete until age 9 yr.

Current harvest: The average annual commercial landing since 1954 has been 17 300 kg (0.29 kg/ha), fluctuating between 2 452 and 55 181 kg.

Other impacts: Changes in the timing, location and intensity of the fishery may have introduced factors that account, at least partially, for changes in the harvest.

A domestic fishery of unknown proportions exists on Tathlina Lake. However this fishery is not believed to be of sufficient magnitude to have a significant effect on stocks.

Major issues

Unusual and unexpected long-term changes in the vital parameters of the Tathlina Lake walleye cause concern. These changes are obscured by fluctuations in harvest, apparently superimposed on an 11 yr cycle of abundance.

Assessment

The data available are difficult to interpret. The quotas appear to have had little effect on actual catches. There was a gradual increase in mean age between 1975 and 1986, an increase in the proportion of fish over 11 yr old and a concurrent reduction in the number of fish under 7 yr of age. The modal length over the same period has remained relatively constant. These results do not provide a readily interpretable picture of the population mechanism operating. At the same time, the high instantaneous mortality rate (0.90 to 1.83) appears too high to be sustainable. However, because the system appears to be driven to a considerable extent by periodic winterkill, it is likely that population and production will vary greatly depending on the frequency and severity with which winterkill occurs.

In view of the high figure for instantaneous mortality, the Subcommittee considers that the annual commercial catch is probably too high to be sustainable at the present time.

Management recommendations

1. Total allowable catch (TAC) should be decreased from 30 900 kg to 20 000 kg to reduce the high total instantaneous mortality. This is the minimum change in quota that is considered likely to be effective.

Research requirements

1. Annual monitoring of the commercial catch should be continued. Biological sampling of the catch should continue to provide information on mean length, age and mortality of the exploited walleye stock. Studies to assess the effect of location and season on the harvest are needed.
2. Additional biological information needs to be collected that might help to determine the cause of the fluctuations in harvest, e.g. investigate winter limnological conditions to predict and assess winterkill.
3. A program should be established to determine the extent of the domestic fishery.
4. A research program should be developed on walleye in its northern distribution in order to improve understanding of the effects of fishing and climatic variation.
5. A review of the situation in five years is needed to determine whether harvest levels should be adjusted.

THE WALLEYE FROM KAKISA LAKE

Background

Kakisa Lake, together with its companion Tathlina Lake in the same drainage (see previous section), yield 74% of the commercial walleye production of the Northwest Territories. Kakisa Lake was first opened to commercial fishing in 1946.

Kakisa Lake has a surface area of 33 000 ha and a maximum depth of 7 m. Walleye is the dominant fish species in the lake; it comprises 84% of the commercial catch.

Stock definition: The stock of Kakisa Lake appears to be discrete; no interchange of tagged fish with Tathlina Lake has been observed.

In summer the walleye are distributed throughout the lake. Smaller or younger fish appear to inhabit the shallows while the larger fish occupy the deeper, open waters.

Stock size: When the commercial fishery was opened in 1946, an annual quota of 91 000 kg was established and the minimum allowable mesh size was set at 89 mm (3.5 in). Beginning in 1962, the quota was reduced to 89 000 kg cumulative over a six-year period, and the minimum mesh size was increased to 114 mm (4.5 in). In 1967 this six-year cumulative quota system again changed. An annual quota was established at 18 000 kg based on an estimated annual production of 0.5 kg/ha. In 1980 the legal mesh size was reduced to 108 mm (4.25 in) and the quota was set at 20 000 kg annually.

Vital parameters: Between 1977 and 1985 the mean length of walleye from the commercial fishery ranged from 378 mm to 410 mm. Since 1982 there has been a decrease in the number of fish <350 mm and an increase in fish 410-450 mm.

Over the same period, mean age increased from 8.6 yr to 10.6 yr. Again, since 1982, the shift toward older mean age has been associated with an increase in fish older than 11 yr and a concurrent decrease in fish 8 yr and younger. However the modal length and modal age have not increased significantly over the same period. In fact, the modal size of walleye caught in the various mesh sizes has remained remarkably constant since 1946.

In 1946 all walleye were mature by age 7 yr. In 1978 some fish were mature by 4 yr, but maturity of all individuals was not attained until age 10 yr.

Total instantaneous mortality between 1977 and 1985 ranged from 0.64 to 1.19. In recent years it has remained in the vicinity of 0.64.

Current harvest: Commercial landings since 1953 have averaged approximately 20 000 kg annually, but with wide annual variation. Harvests ranged from 5 095 kg in 1955 to 72 365 kg in 1966. Since 1968 when the annual quota was set at 18 000 kg, annual production has remained relatively constant, averaging 19 400 kg. The annual harvest in the 1980's has averaged 0.85 kg/ha, which is in the upper range for northern Canadian walleye fisheries.

A domestic fishery exists on Kakisa Lake but its extent and effects have not been estimated.

Other impacts: None known.

Major issues

The severe fluctuations in harvest (72 000 kg in 1966 to 5 059 kg in 1955) have occurred for reasons that are not understood. Natural causes are indicated by the magnitude of these fluctuations which appear to be too large to be accounted for by changes in fishing effort. As in Tathlina Lake, partial winterkill may be responsible, although little information is available on winter limnological conditions.

Assessment

Changes in the size and age distribution occurring between 1977 and 1985 are difficult to explain. There has been a significant increase in the number of fish older than 11 yr, although modal lengths and modal ages have not changed significantly over this period; in fact, the modal length of walleye has not changed appreciably since 1946.

There are changes in the age at maturity which appear to conflict with established theory. It is generally believed that harvesting a population tends to reduce the age at which maturity is attained. In the present case maturity appears to be uncoupled from age rather than that a change in any specific direction has been effected.

Contrary to what might be expected, there was no significant change in growth rates between 1966 and 1978. This seems to indicate that over-fishing has not occurred, and this is substantiated by the absence of any significant decline in abundance.

Management recommendations

1. The commercial quota should not exceed 20 000 kg annually, provided the domestic catch does not exceed 9 000 kg.

Research requirements

1. Annual monitoring of the commercial catch should be continued.
2. The domestic catch should be monitored for three consecutive years.
3. A review of the commercial quota in five years time is needed in order to make any necessary changes or adjustments.

SEA-RUN ARCTIC CHARR OF THE CENTRAL ARCTIC AND BAFFIN ISLAND

Background

This review covers anadromous Arctic charr stocks in the Central Arctic and Baffin Island (Management Regions IV, V and VI) but excluding the Inuvialuit Settlement Region.

The migration pattern of Arctic charr differs from that of most anadromous salmonids in that charr migrate to the sea during the open-water season for a relatively short feeding period. They return to fresh water in the fall to overwinter. The majority of the fish in the seaward and return "runs" are non-maturing since spawners of the current year, for the greater part, remain in fresh water. Individuals spawn at intervals of two to four years, the interval depending on feeding conditions in the sea in the intervening years. In many systems a significant fraction of the larger fish migrate to other river systems; at the same time, there is an apparent influx of smaller fish compensating for the departure of the larger ones. The net result is that the stock remains remarkably constant in number and mean size. Growth in the sea varies greatly from year to year. Good years, in which the growth may be many times greater than in the average year, occur relatively infrequently (about once every 7-8 yr on the basis of limited information). The extent to which a stock depends on these good years to carry it through lean years is not known; it is probably quite high, because there are extremely poor years at about the same frequency, in which the charr return to fresh water in marginally better condition than when they left.

Fishing usually takes place during the upstream or downstream run. In the region under consideration, 124 separate anadromous stocks have been allocated commercial fishing quotas based largely on the experience and judgement of fishery management personnel. In any year, approximately 60% of the fisheries are open; these are the primary fisheries. Other fisheries are opened on request. In establishing quotas, account is taken of the size of stream, the extent of the associated lake system and,

where available, the fishing history. For example, there may be a history of traditional Inuit usage, or there may be Royal Canadian Mounted Police (RCMP) records from former times when charr was harvested for dog food.

Most charr stocks are fished domestically, but virtually no data exist on harvest size. The major commercial fisheries are centred at Cambridge Bay, Victoria Island, Pond Inlet and Cumberland Sound, Baffin Island, and the Keewatin Coast of Hudson Bay. Certain stocks, particularly those near settlements, experience considerable pressure from the recreational fishery in which northern residents, native Inuit and itinerant anglers of southern origin all participate.

The data on stock abundance and harvest for the majority of the rivers and lakes are extremely meagre. In relatively few cases, mainly where a commercial fishery exists, are continuous data available over any appreciable length of time. The source of many of the detailed aspects of Arctic charr life history and population dynamics is the Nauyuk Lake study. This major scientific study, sited on the Kent Peninsula, has been operating since 1974. It has proved very valuable as a point of reference against which other systems may be compared.

Stock definition: For management purposes, the various river systems with known Arctic charr runs are treated as discrete stocks. Because specific information on stock identification is lacking, it is believed that such an approach provides the greatest possible degree of protection to the populations of the whole region. In view of the known mixing of stocks in the sea, this approach necessitates a "two tiered" view of any production area; at the lower level is the individual river, and at the higher level is the area containing the several rivers among which interchange of individuals may take place.

Stock size: Stock sizes vary greatly, from the large run (over 183 000 upstream migrants) in the Ekalluk River, to small runs of one or two thousand individuals. The most satisfactory method of enumerating stocks is through the erection of a counting fence or weir. However, this does not provide an entirely accurate count of the total population because spawners of the current year frequently remain in freshwater throughout the summer. It has been possible to enumerate only a few stocks in this way.

Vital parameters: In the Central Arctic, anadromous Arctic charr stocks have a mean age of 14-16 yr. Many individuals reach an age of 20-25 yr or even more, and a maximum length of about 950 mm. Modal length is usually between 600 and 700 mm. Growth is slow in all regions. Juveniles first go to sea at the age of 5-8 yr and a length of about 200 mm. After one or two annual migrations to the sea, and attainment of a length of 300 mm, growth is relatively rapid. The adult modal size is reached after two to three more migrations. Recruitment to the adult stock thus takes place between the ages of 9-11 yr. Within the sea-going portion of a given stock most fish are relatively uniform in size, although exhibiting considerable variation in age. This growth pattern results in a strongly bimodal length-frequency distribution.

This bimodal length-frequency distribution in the sea-going population appears to be quite stable, even in the face of severe exploitation. Following the initiation of a fishery on a previously untouched stock, there is an initial decline in mean age of the modal-sized fish, and a loss of the largest fish, but in subsequent years length- and age-frequency distributions remain quite constant. As the population is "fished down" there are thus very few changes indicating a condition of "over-fishing" apart from a decline inabundance. Finally, if the population continues to be exploited there is an abrupt decline (within one or two years) in the size of the major mode, although the characteristic bimodal length-frequency distribution is still maintained. This sudden change in the modal length is generally coincident with a collapse of the fishery. Collapse in this case may be defined as a sudden decline in modal length and poor returns on effort expended.

Following collapse of a fishery, the most effective treatment is to completely prohibit fishing for a number of years. The capacity of the population to recover has been demonstrated by the fishery in Wellington Bay (now the major commercial fishery in the region).

If the establishment of an annual fishery is the goal of management, one of the most valuable pieces of information is the documented collapse of a run. In these circumstances the harvest is clearly in excess of the capacity of the stock to produce. Naturally, this cannot be recommended as a viable management procedure, but in view of the regrettable frequency of collapse, good documentation on all runs is extremely valuable. The capacity of charr stocks to recover when left completely undisturbed is considerable, so that if or when recovery has been achieved there will exist a known figure for over-harvest. This is a valuable point of departure for the estimation of a quota that may ultimately lead to a sustainable fishery.

Current harvest: The total annual commercial harvest of Arctic charr is between 140 and 150 tonnes, of which about half is shipped to southern markets. The largest fishery is at Wellington Bay on Victoria Island, the catch being exported from Cambridge Bay. This fishery has been relatively stable for a number of years. It accounts for 35% of the total commercial catch and 80% of the charr shipped south. Details of the catches of individual rivers are given in the Recommendations section. The total domestic catch of the region is estimated at about 300 tonnes.

A number of charr runs, particularly those near settlements (e.g. Freshwater Creek at Cambridge Bay and the Sylvia Grinnell River at Iqaluit) are subject to heavy domestic pressure and intensive recreational fishing by local resi-

dents. The combined effect is to perpetuate formerly productive systems at very low levels of production. Except for certain well-known locations (e.g. Tree River) recreational fishermen from the south (i.e. non-resident sport fishermen) appear to have relatively little impact on charr stocks. Where the impact is large (as at Tree River and Jayco River), fishing is rigorously controlled.

Other impacts: None identified.

Major issues

The major issue is the method for management of charr fisheries. The method used in the important Wellington Bay fishery has to date been the most successful. Management has been based on a number of factors. The collapse of the fishery in the late 1960's provided knowledge on unsustainable harvest levels. At the same time, this overfishing inculcated a cautious approach to the fishery, on the part of both managers and fishermen. From experimental work at Nauyuk Lake, it is evident that annual exploitation needs to be less than 10% of the total stock. A counting fence on the Ekalluk River in 1983 indicated a stock of about 183 000 individuals. The annual quota is 14 500 kg, but actual harvest may be close to 37 000 kg. Recovery of tagged fish indicates exploitation is near 10% on this system. This production has been maintained since 1978. However, continued vigilance is essential since the data indicate an increase in mortality rate in recent years.

The management method used in the Wellington Bay fishery has been developed in full consultation with the Cambridge Bay Co-operative fishermen. The present quota is based on the known value of an excessive harvest that caused collapse of the stock in the late 1960's. There is undoubtedly mixing of the stocks from various rivers in the Wellington Bay area during the summer open-water season; therefore the stock can be treated as a single unit conceptually. However, overall quotas for the whole area were tried but found impracticable, due to the long time-lag in redistribution following depletion of one stock. Individual quotas have thus been established for the several rivers entering Wellington Bay, with the intent of distributing the harvest more uniformly.

Assessment

The dispersed nature of the stocks to be managed and the immense area to be covered preclude the collection of the requisite management data at each location. It is therefore essential to concentrate effort on a relatively small number of the most important systems. As experience is gained it will be possible to develop a better appreciation of the difficulties and constraints on Arctic charr production and also gain insight into possible management techniques.

Considerable progress has been made in the development of a conceptual model of the Arctic charr life history and productive capacity. The known features preclude the application of current mathematical models except to a very limited degree.

The Subcommittee recognizes the need for innovative management of Arctic charr stocks. It strongly supports the measures now in place. There is considerable evidence that recovery of stocks following collapse can be full and relatively rapid if the appropriate measures are adopted. To a large extent this involves imposing maximum constraint on the fishery for a limited period of time. Depleted streams, formerly good producers, will be restored to full productivity only with the help and co-operation of the local residents. If success could be attained at a single location it would serve as a model for other areas.

The Subcommittee fully endorses the method of management being developed for the Wellington Bay/Cambridge Bay area. It is the most practical and efficacious method available to date.

Management recommendations

1. Rehabilitation of charr stocks should be attempted in such streams as Freshwater Creek (Cambridge Bay) and Sylvia Grinnell River (Iqaluit) by reducing the impact of domestic and recreational fishing.
2. Offical naming of all rivers for which Arctic charr quotas have been allocated should be initiated. This would facilitate the identification of rivers and their charr stocks.
3. The quotas for Arctic charr in the water bodies designated in Table 4, should not be exceeded.

Research requirements

1. Concentrated efforts should be made on monitoring and assessment of the major charr stocks and the build up of a substantial data base on each stock. This is essential for the development of both conceptual and numerical models.

REPORT OF THE AFSAC FISH SUBCOMMITTEE: 1987/88

The second annual meeting of the AFSAC Fish Subcommittee was held on 15-16 February 1988. The main purpose of the meeting was to examine status reports on Arctic fish stocks.

Membership of the Subcommittee for 1987/88 was:

L. Johnson	(Science, Central and Arctic Region) Chairperson
J. Craig	(Science, Central and Arctic Region)
C. Hudon	(Science, Quebec Region)
A. Kristofferson	(P&FF, Central and Arctic Region)
J. Reist	(Science, Central and Arctic Region)

The Subcommittee reviewed the following background documents.

Interim Report on the Status of the Broad Whitefish (Coregonus nasus) Stocks of the Lower Mackenzie Basin. R.F. Baker. (AFSAC Document 87/88-2)

Update on the Status of Lake Trout in Great Bear Lake, Northwest Territories. M.M. Roberge. (AFSAC Document 87/88-3)

The Walleye of Mosquito Creek, Northwest Territories. M.M. Roberge. (AFSAC Document 87/88-4)

Stock Status of Arctic Charr in the Firth River, Yukon Territories. A. Kristofferson and R. Baker. (AFSAC Document 87/88-5)

Stock Status of Arctic Charr in the Babbage River, Yukon Territories. A. Kristofferson and R. Baker. (AFSAC Document 87/88-6)

Stock Status of Arctic Charr in the Rat River, Northwest Territories. A. Kristofferson and R. Baker. (AFSAC Document 87/88-7)

Stock Status of Arctic Charr in the Big Fish River, Northwest Territories. A. Kristofferson and R. Baker. (AFSAC Document 87/88-8)

Stock Status of Arctic Charr in the Hornaday River, Northwest Territories. A. Kristofferson. (AFSAC Document 87/88-9)

Stock Status of Arctic Charr in the Kuuk River, Northwest Territories, A. Kristofferson. (AFSAC Document 87/88-10)

Status of Arctic Charr in Freshwater Creek, Northwest Territories. A.H. Kristofferson, G. Carder, D.K. McGowan and G. Low. (AFSAC Document 87/88-11)

Recommended Commercial Fishing Quotas in the Northwest Territories. A. Kristofferson, L. Dahlke and G. Low. (AFSAC Document 87/88-12)

Earlier, in May 1987, the Subcommittee reviewed one background document:

Stock Assessments for Arctic Charr of Steensby Inlet Area, Northwest Territories. M.M. Roberge. (AFSAC Document 87/88-1)

This was in response to an urgent request for advice from the Regional Director, Fisheries and Habitat Management.

The instructions to the Subcommittee were: 1) to examine the stock status reports, 2) to comment on the current status of the stock in the light of fishing activity, 3) to consider recommendations on future utilization, and 4) to develop proposals for the research necessary to provide information for efficient management of the stocks.

The Fish Subcommittee Chairman thanks all those who participated in the activities of the Fish Subcommittee of AFSAC for their enthusiasm and effective contributions to the AFSAC process.

COREGONIDS OF THE MACKENZIE DELTA

Introduction

The report submitted on broad whitefish was prepared as part of a detailed investigation of the area fisheries. This interim report was accepted in order to avoid unnecessary duplication of effort, particularly when it is recognized that the useful information is extremely limited.

The Mackenzie Delta is an exceedingly complex waterbody supporting fisheries on five species of coregonids: broad whitefish, lake whitefish, least cisco (Coregonus sardinella), Arctic cisco (C. autumnalis) and inconnu. A relatively small number of Arctic charr also pass through the region during their annual migration.

The existing management system is based on commercial quotas set for each of five areas in the Delta (Schedule V, Northwest Territories Fishery Regulations). The domestic fishery is unregulated, but probably constitutes several times the commercial catch. Virtually no reliable information exists on the domestic fishery. Broad whitefish is the most important species.

The Mackenzie Delta fishery is a fishery manager's nightmare. Not only is the waterbody extremely complex, but very complicated migratory patterns are evident in all species; these are slowly being elucidated. There is virtually no knowledge of the discreteness of the various stocks nor the localities they inhabit.

Management recommendations

In view of the paucity of information it is recommended:

1. Present commercial quotas should not be changed.
2. The magnitude of the total catch should be assessed according to:
   a. location of fishery;
   b. species taken;
   c. quantity of each species and catch per unit effort.
3. Adverse fishing practices (e.g. blocking of entire migratory corridors) should be actively discouraged.
4. Commercial areas should be redefined, and the setting of realistic area/stock quotas should take cognizance of the extent of the domestic fishery. In some areas there is heavy fishing pressure upon stocks congregating in narrow corridors.

Research requirements

As noted above, the major impediment to management of broad whitefish in the lower Mackenzie River is lack of detailed knowledge accumulated on a stock-specific basis. The following recommendations address these issues. They are listed in order of priority for 1988/89, although all are multi-year studies.

1. Research on structuring into genetic stocks must continue in order to develop a foundation upon which future research and management may be organized and executed.
2. In association with 1 above, studies of migratory fish must be conducted to further understand the movement patterns of the stocks.

3. A detailed study of the fishery in Arctic Red River should be carried out because the whitefish stocks are suspected of being over-fished and this location is a suitable trial situation for test fishery and sample collections.
4. Upon adequate (or extrapolated) definition of individual stocks, appropriate estimates of abundance should be made on a stock-by-stock basis. This could begin in 1991/1992 or earlier. In the interim, assessment of the research tools available, including hydro-acoustic methods is necessary in view of the size and logistical difficulties of areas to be investigated.
5. By 1990/91 at the latest, relatively unimpacted population(s) of broad whitefish should be identified and reserved for investigation into the experimental manipulation of riverine coregonids. Preliminary assessment of these should begin in 1989/90. Feasible candidate populations (as of February 1988) are the Kugalik River and Miner River immediately east of the Mackenzie River.

Next AFSAC review

The following reports should be prepared for and reviewed by AFSAC in 1988/89 deliberations.

1. The final report on broad whitefish should be reviewed.
2. State-of-knowledge and, where possible, specific stock status reports for the remaining coregonids of the lower Mackenzie River are required. These include: lake whitefish complex, Arctic cisco, least cisco and inconnu.

THE LAKE TROUT OF GREAT BEAR LAKE

Background

Great Bear Lake is the largest lake entirely within Canada. It is deep and cold, supporting in its pristine state a large population of large lake trout. Stocks of other species are extremely limited. For this reason the lake has never been fished commercially. A domestic fishery has been in operation out of Fort Franklin for very many years and the possibility of a limited commercial fishery is being investigated. Recreational fishing for the large lake trout began in the late 1950's with the establishment of two sport fishing lodges. This number subsequently grew to five lodges distributed around the lake periphery, exploiting all the inshore waters except those in Keith Arm and the southern part of McVicar Arm. Even under recreational fishing alone, the mean size of individuals in the stock declined, in some instances to the point where lodge operators considered it worthwhile to move to new locations.

Various government regulations have been introduced to reduce the harvest of lake trout with the aim of maintaining the fishery for "trophy" lake trout. Certain lodges maintain a policy of keeping only trophy fish, all others being released.

Stock definition: Information on stock identity is lacking. Lake trout in Great Bear Lake are believed to be relatively sedentary. This conclusion is based on tagging studies, differing rates of parasite infestation in different regions of the lake and differences in morphology. Therefore, with the exception of McTavish Arm, it is assumed that there is at least one stock of lake trout in each of the following areas: Smith Arm, Dease Arm, Keith Arm and McVicar Arm. Differences in the age composition of gill net catches of lake trout from two locations within McTavish Arm suggest at least two stocks reside there. Thus, for management purposes, it is assumed that there are at least six stocks of lake trout in Great Bear Lake. Preliminary results of intensive creel surveys suggest the possible existence of other stocks. However, the data are insufficient at this time to warrant attribution of stock status.

Stock size: No information is presently available on the size of each stock in Great Bear Lake.

Vital parameters: There is a paucity of information on the vital parameters of lake trout in Great Bear Lake. Generally, growth is slow. At 5 yr, trout are about 30 cm long; at 10 yr, 45 cm; at 15 yr, 55 cm and at 20 yr, 65 cm. Rate of growth slows after 20 yr. Trout, believed to be in excess of 50 yr of age, have been taken from the lake. Ages at first maturity and at 100% maturity are approximately 15 and 26 yr, respectively. Instantaneous natural mortality (catch curve) is estimated between 0.08 and 0.12.

Current harvest: Total harvest of lake trout for 1987, based on an angler diary and creel census, was 8 248 fish (95% C.I. = 8 063-8 693). Following is a breakdown of the harvest, by stock, in 1987:

Stock	Harvest	Lodge Involved
McTavish Arm (north)	1 757	Arctic Circle, Branson's
McTavish Arm (south)	1 126	Branson's
Dease Arm	2 060	Great Bear Lake Lodge
Smith Arm	2 152	Trophy, Branson's Outpost
Keith Arm	0	No fishing
McVicar Arm	1 153	Great Bear Lodge & Outpost

Other impacts: Itinerant fishermen are known to fish for lake trout in Great Bear Lake; their impact on the stocks is unknown but probably very minor.

Major issues

The Great Bear Lake Management Committee was established in 1986 to ensure that the domestic fishing needs of the Satudene residents of Fort Franklin are met, as well as to ensure that a high quality lake trout recreational fishery is sustained on the lake.

Assessment

Stock prognosis: Yields of lake trout have declined, but in most cases stocks now appear to be stabilizing after an initial period of heavy fishing. Previous yield estimates (kg/utilized ha) ranged from 0.11 to 0.95; in some cases this is in excess of the 0.5 kg/ha thought to represent sustainable yield. All stocks, with the exception of those of Keith Arm, are at present being exploited by the recreational fishery. The Great Bear Lake Management Committee has reserved the use of Keith Arm for the residents of Fort Franklin. Thus, there is no opportunity to expand the recreational fishing industry by exploiting previously unexploited stocks. Yield per recruit analysis has provided estimates of equilibrium yield. Maximum equilibrium yield of lake trout in Great Bear Lake is estimated to be 0.13 fish/utilized ha. The current harvest is below this maximum yield. However, the Great Bear Lake Management Committee has recommended that the lodge-based recreational fishery be managed as a 'trophy' fishery. Estimated yield required for such a fishery on Great Bear Lake ranges from 0.04 to 0.095 fish per utilized ha to produce maximum yields of fish longer than 900 mm or 700 mm respectively. Using these yields as a guide and taking into consideration the loss to the population through release mortality (assumed to be 7%), total allowable catches (TAC's) were calculated for each stock by applying the yields to the current utilized areas. In most cases recommended TAC's are similar to existing harvest levels.

Management recommendations

1. The following TAC's (number of fish) are recommended for lake trout stocks in Great Bear Lake:

Stock	TAC
McTavish Arm (north)	1 500
McTavish Arm (south)	1 500
Dease Arm	2 000
Smith Arm	2 500
Keith Arm	0
McVicar Arm	1 500
Total	9 000

Research requirements

1. A stock identification program (genetic and morphometric studies) should be initiated to further delineate stocks of lake trout in Great Bear Lake.
2. Detailed studies of the population dynamics of lake trout in Great Bear Lake are required to determine optimum yield.

Next AFSAC review

February 1994, after five years of harvest at the recommended levels.

THE WALLEYE OF MOSQUITO CREEK

Background

Walleye from Great Slave Lake spawn in Mosquito Creek each spring. No other spawning areas have been identified. Tagged spawners in this creek have been recaptured as far south as Baker Point on the western shore of Great Slave Lake. The walleye on their spawning migrations in Mosquito Creek comprise a major recreational fishery in the area. Information on angler harvest and biological characteristics of the spawning population have been collected during the 1970's and 1980's. A counting weir was installed across Mosquito Creek in 1986 to enumerate the spawning run. The fish are also exploited at other times of the year by Great Slave Lake commercial and domestic fisheries but no data exist on the extent of this exploitation.

Stock definition: Walleye spawn in Mosquito Creek each spring and after spawning disperse over a wide area of Great Slave Lake. Since walleye tend to home to the same spawning areas, the Mosquito Creek population may be considered a distinct stock.

Stock size: Estimates of population numbers (minimum) of the spawning fish were 5 600 in 1975, 2 800 in 1986 and 800 in 1987.

Vital parameters: Changes in the walleye harvested by anglers between the 1970's and 1986/87 include a decrease in fish <8 yr and <400 mm and an increase in fish >13 yr and > 460 mm. Annual mortality rate has increased from 0.50 in 1974/75 to 0.62 in 1986 and 0.59 in 1987. The significance of differences in these rates is difficult to determine because of the lack of confidence limits for the estimates. Over the last two decades, there has been a decrease in the proportion of female spawners.

Current harvest: Catch per unit effort (CPUE) expressed as numbers of walleye caught per angler per hour remained fairly constant from 1975 to 1983 (0.5 - 0.6) but increased dramatically in 1986 (1.0). It returned to the previous level in 1987 (0.4). However, the total number of anglers and thus the total number of fish harvested (caught) increased considerably from the 1970's (285 in 1975) to the 1980's (1 298 in 1983, 2 928 in 1986 and 732 in 1987).

Harvests of walleye by commercial and domestic fishermen in Great Slave Lake are unknown.

Prior to 1974, catch and possession limits in Mosquito Creek were ten and ten; in 1974 they were reduced to five and ten. No quotas are placed on the Great Slave Lake fishermen although the North Arm was closed to commercial fishing in 1974.

Other impacts: The spawning run in Mosquito Creek is limited by culverts under a road bridge 5 km from the creek mouth which prevent further upstream migration of the walleye.

Major issues

The fishery is an important social event for the area although it may not have high economic returns.

Assessment

Stock prognosis: Catches in the 1980's have consisted of larger, older spawners than those in the 1970's. The percentage of females has declined. There is also evidence that the number of year classes in the spawning run has declined and that there is poor recruitment to the spawning stock. There may be a need to re-examine current ageing techniques, such as scale reading, which are suspect. Fin rays of live fish and opercular bones of dead fish may be considered. Although the status of the stock cannot be quantified, the evidence collected suggests serious overexploitation and a decline in the spawning stock.

Management recommendations

1. The recreational fishery should be closed from April to June for three to five years.
2. A passage for migrating walleye past the culverts should be provided to increase available spawning habitat.

Research requirements

1. The spawning run should be monitored annually to determine the effectiveness of the closure and habitat improvements. Age class distribution (year-class strengths), size distribution and proportion of females should be measured to determine the viability of the stock.

Next AFSAC review

The fishery should be reviewed again in three to five years after it has been re-opened.

ARCTIC CHARR IN THE FIRTH RIVER

Background

The Firth River is the most westerly river of the Yukon North Slope. Its headwaters as well as those of its major tributary, Joe Creek, are in Alaska. The river flows 160 km in a northeasterly direction to discharge into the Beaufort Sea, close to Herschel Island. The entire Canadian portion of the Firth River lies within the Inuvialuit Settlement Region and the Northern Yukon National Park.

The Firth River supports an anadromous population of the western form of Arctic charr as well as a resident, or non-anadromous form. The western form goes through its life cycle more rapidly than the eastern form (inhabiting rivers east of the Mackenzie River), and is somewhat smaller.

Stock definition: Preliminary results indicate that the two major overwintering areas in the Firth River, and in Joe Creek, support genetically distinct stocks of charr. They are also distinct from stocks in the neighbouring Babbage River. The anadromous charr from both the Firth River and Joe Creek migrate to the Beaufort Sea in summer, moving along the coast to Herschel Island, Nunaluk and Kaktovik Lagoons, and even as far as Canning River. Tagging indicates some mixing of non-spawning stocks occurs but that the degree of reproductive homing is high.

Stock size: An aerial survey in 1972 estimated the population as roughly 32 000 (no confidence limits given). No recent estimates are available.

Vital parameters: Mean lengths of sexually mature males and females in 1972 were 575 mm and 625 mm, respectively. The average fecundity was 4 955 ± 463 eggs/female. Fish up to 15 yr old were encountered. First maturity was reached at 4 yr. Mature fish were 350 to 820 mm long. Stream residents were smaller (maximum 390 mm) and younger (maximum 11 yr) than the anadromous form.

There is no information on recruitment or mortality.

Current harvest: Historically, the Firth River charr have been fished lightly. In 1962, the RCMP reported taking 5 000 fish during ten days of fishing. In 1965, 7 000 kg were taken from Ptarmigan Bay, south of Herschel Island, most of which are believed to have been Firth River stock.

The Firth River is recognized as a good region for recreational fishing, but the actual number of recreational fishermen visiting the area is not known.

Other impacts: Arctic charr feeding in the sea remain close to shore; they are therefore vulnerable to shoreline disturbance such as oil spills, etc. Any impediment to migration through river disturbance (causeways, culverts, etc.) could affect the stock adversely.

Major Issues

Transboundary stock: Overwintering areas in the upper Firth River and Joe Creek straddle the Yukon/Alaska boundary. Tagging studies have revealed that charr migrate into Alaskan waters along the Beaufort Sea coast. A joint Canada-USA management strategy is essential.

Assessment

Stock prognosis: Virtually nothing is known of the stock size, or the response of the Yukon North Slope populations to exploitation. It is recognized that information gathered on the Central Arctic stocks (eastern form) cannot be applied indiscriminately to the Yukon North Slope stocks. Charr in the Yukon rivers grow faster, are generally smaller, and have life spans considerably shorter than their Central Arctic relatives.

Management recommendations

1. TAC should not exceed 1 600 charr annually from the Firth River until such time as additional information for a more refined estimate becomes available. A fishing plan should be developed based on this TAC.
2. The magnitude and nature of the recreational harvest of Arctic charr on the Firth River must be documented.
3. A joint Canada-USA management plan should be implemented to protect critical transboundary spawning/overwintering areas and to control exploitation along the Canada-USA coastlines to ensure that the TAC is not exceeded.
4. Commercial fishing in Ptarmigan Bay during summer is not recommended at this time since mixed stock fishing (Firth-Babbage stocks) is likely to occur and the relative contributions of different stocks to the fishery will not be known. Some experimental (catch and release, hoop net) fishing could be carried out along the coastline to determine the extent of the feeding migration of Firth River charr. Approximately 500 charr were tagged in the Firth in 1987 and most should be available for recapture in 1988. Recaptures will provide a current minimum exploitation rate.

Research requirements

1. The suspected genetic discreteness of Arctic charr spawning in Joe Creek and the upper Firth River should be further investigated. If studies prove that there are two discrete stocks, their abundance should be estimated at each location by mark-recapture techniques during the upstream migration (Schaefer method) or on the spawning/overwintering grounds (Petersen method). Separate fishing plans should then be established for each stock. Baseline biological data such as stock size/age distribution and mortality rates should be collected simultaneously with estimates of abundance. The stock(s) can then be monitored during exploitation. Changes to stock structure/abundance will reveal the effects of exploitation. This being the case, TAC's can then be adjusted accordingly.
2. Detailed studies of the population dynamics of at least one stock of western Arctic charr should be initiated to determine exploitation rates best suited to this form of Arctic charr.
3. The extent of the genetic contribution by residual stream-resident male Arctic charr to the anadromous stock should be determined.
4. The extent of mixing of overwintering (non-spawning) Arctic charr in different river systems should be determined as this may result in mixed stock fisheries.

Next AFSAC review

February 1990.

ARCTIC CHARR IN THE BABBAGE RIVER

Background

The Babbage River and its major tributary, Fish Hole Creek (Canoe Creek), drain the Yukon North Slope, entering the Beaufort Sea in Phillips Bay, 190 km west of Inuvik; it forms the eastern boundary of the Northern Yukon National Park. The Babbage River contains stocks of the western form of Arctic charr as well as two non-anadromous forms. The anadromous stock utilizes the southern shoreline of the Beaufort Sea during the summer. Historically these stocks have been lightly exploited.

Stock definition: Studies indicate that the anadromous charr of the Babbage River are discrete from the neighbouring Firth River stock. The main overwintering and spawning area is in Fish Hole Creek. Falls on the main stem prevent the anadromous stock utilizing the whole river.

The anadromous charr are of large size, relatively fast growing and of high fecundity.

Stock Size: There is no estimate of abundance for this stock.

Vital parameters: A survey in 1974 found that the length of the charr ranged from 260 mm at 3 yr of age to 559 mm at 11 yr. The maximum size recorded was 629 mm. These fish appear to be somewhat smaller and younger than those of the Firth River.

Age at first maturity for both sexes is 5 yr; all fish appeared to be mature by age 8 yr. The sex ratio favoured females in the proportion 1.42:1. Fecundity is relatively high (3 468 eggs/female).

In 1987, gillnet samples from the mouth of the Babbage River indicated a size range from 187-635 mm, with 80% between 350 and 524 mm. Ages ranged from 5-13 yr with a mean of 8.2 yr. Instantaneous mortality based on catch curve data was 0.47.

Spawners from Fish Hole Creek, the major tributary of the Babbage River, had a length range of 300-611 mm, with a mean of 495 mm. They had a mean age of 9.5 yr.

Current harvest: Fishing on the Babbage River during historical times has been light, possibly because of the distance from the settled areas. It is possible that some Babbage River charr are taken at Shingle Point or Stokes Point, but this is not known for certain. Some recreational fishing is believed to take place by itinerant anglers, although the current level of exploitation is unknown.

Other impacts: Arctic charr remain close to shore while feeding in the sea. There is thus the possibility of considerable damage from an oil spill, should such occur in the offshore area.

Any construction (road or pipeline) along the shore of the Beaufort Sea could adversely affect charr stocks.

Major issues

The Big Fish River was closed to all fishing in 1987 due to overexploitation, therefore new sources for the people of Aklavik and Inuvik will be sought. The closest stock to Inuvik and Aklavik is in the Babbage River. It is likely that this stock will be subjected to increasing exploitation in the near future.

Assessment

Stock prognosis: Although the most detailed information was collected in 1974, more recent collections indicate that there has been very little change. Since there is no information on the stock abundance, it is not possible to establish reliable TAC's at this time. A provisional TAC of 500 charr, based on an assumed stock of 10 000 exploited at a rate of 5%, is suggested. This is a reference level catch subject to modification when further information becomes available.

Management recommendations

1. A reliable annual TAC cannot be set with the available data. Hence a provisional annual catch of 500 Arctic charr (which should accommodate the existing recreational fishery) is recommended at this time.
2. Exploitation level should not exceed 5% of estimated stock. It would be possible to determine minimum exploitation level from the number of recaptures of charr tagged on the Babbage River in 1987.
3. The extent of current exploitation (angling) on the Babbage River should be determined.

Research requirements

1. The stock identity and stock discreteness of the anadromous Arctic charr of the Babbage River, relative to the adjacent Firth River and Big Fish River stocks, should be confirmed.
2. The abundance of anadromous Arctic charr in the Babbage River should be estimated using mark-recapture techniques on upstream migrants (Schaefer method) or on spawning/overwintering grounds (Petersen method). Baseline biological data on size/age structure of the stock should be gathered simultaneously with population estimates such that the effects of future exploitation on this stock may be measured.
3. The summer feeding distribution of Babbage River charr should be determined by experimental fishing with non-destructive gear (trap nets, hoop nets) along the coast in an attempt to recapture the charr tagged in 1987.
4. The extent of the genetic contribution by residual males to the anadromous stock should be determined.
5. Since little is known of the population dynamics of the western Arctic-Bering Sea form of Arctic charr and its response to exploitation, it is recommended that the Babbage River anadromous Arctic charr stock be the subject of detailed studies of population dynamics so that exploitation rates, sustainable by this form of Arctic charr, may be determined.

Next AFSAC review

February 1990.

ARCTIC CHARR IN THE RAT RIVER

Background

The Rat River is located 90 km southwest of Inuvik, NWT. It flows east out of the Richardson Mountains joining the Peel River between Fort McPherson and Aklavik. Anadromous Arctic charr of the western form inhabit the river. They descend the Mackenzie River to the Beaufort Sea for their summer feeding. During their return migration they are exploited by the Inuit of Aklavik as they pass the settlement, and then by the Dene fishermen of Fort McPherson as they move upstream.

Stock definition: The Rat River stock of Arctic charr is considered to be genetically distinct from that of the adjacent Big Fish River, and thus distinct from other Yukon North Slope stocks.

Stock size: Difficulties have been experienced in attempts to enumerate the Rat River charr stock using a weir, high water levels having forced its removal before completion of the run. In 1983, between 8-30 August, 1 312 charr were counted moving upstream. Fifty-seven percent of these were identified as current-year spawners. This count is evidently an underestimate as the run was in progress when the weir was installed and was not over when it was removed. A very rough Petersen estimate suggests a stock of 3 900 fish, but any confidence limits around this value would be inappropriate.

Vital parameters: This stock showed a bimodal length distribution in the anadromous portion of the stock, the smaller mode (315 mm) being large compared to that in eastern stocks. The major mode (400-450 mm), conversely, was comparatively small. Mean length was 413 mm. Youngest mature males were 5 yr old and females 6 yr old. Most fish were mature by the age of 8 yr. The sex ratio favoured females 3.8:1. Mean fecundity was 4 221 eggs/female.

Samples of the commercial catch in 1986 ranged in length from 256 to 572 mm, with a modal value of 375 mm. Age ranged from 4 to 9 yr, with a mode at 6 yr. Instantaneous mortality, for the years 6 to 8, was 1.13; annual mortality was thus 68%.

Current harvest: Historically, harvests have been heavy: 6 500 fish were taken in 1972 and 2 600 in 1973. In 1975 the harvest was estimated at 2 100 charr. In 1983, fisherman interviews indicated a harvest of about 500 fish, in 1984, 400 and in 1985, 200. In 1986, it is estimated that 1 000 charr were harvested.

The recreational harvest is not known, but probably is light.

Other impacts: Since this stock descends to the Beaufort Sea for summer feeding, it is subject to the possibility of contamination if oil spills should occur in this region.

Any development of roads or pipelines causing stream obstructions would be detrimental to the stock.

Major issues

Joint exploitation by residents of Fort McPherson and Aklavik: The return migration from the Beaufort Sea takes the stock close to Aklavik, where it is exploited by the Inuit. Further upstream it is exploited by residents of Fort McPherson. Any management plans will have to be agreed upon by the two communities. Closure of the Big Fish River to fishing in 1987 could increase the pressure on the Rat River stock.

Assessment

Stock prognosis: The Rat River has a history of heavy fishing, but recently catches have dwindled. Recent samples show smaller size and younger age than formerly. Calculated annual mortality of 68% is indicative of heavy overexploitation.

Overexploitation of the Rat River stock is strongly suspected and this may necessitate cessation of fishing if the stock is to be given a chance to recover. This may be difficult for the fishermen to accept without firmer evidence.

Management recommendations

1. Since the Rat River Arctic charr stock is suspected of being overexploited, no commercial fishing should be allowed in 1988.
2. Discussions should be initiated between the communities of Aklavik and Fort McPherson to reduce or cease domestic fishing for Arctic charr, if studies show that the stock is overexploited.

Research requirements

1. The discreteness of the stock of anadromous Arctic charr in the Rat River, relative to the adjacent Big Fish River, should be confirmed.
2. The abundance of anadromous Arctic charr in the Rat River should be estimated in 1988 using mark-recapture techniques on upstream migrants (Schaefer method) or on spawning/overwintering grounds (Petersen method). Baseline biological data on size/age structure of the stock should be gathered simultaneously with population estimates to determine the status of the stock. If results show overexploitation, a recovery strategy should be developed and implemented.
3. Detailed studies of the population dynamics of western Arctic charr should be conducted to determine sustainable exploitation rates.

Next AFSAC review

February 1990.

ARCTIC CHARR IN THE BIG FISH RIVER

Background

The Big Fish River rises in the Richardson Mountains, flows northeastward, and then discharges into Moose Channel of the Mackenzie Delta. Arctic charr of the western form inhabit this drainage. Only one tributary of the Big Fish River, Cache Creek, is known to have suitable overwintering and spawning grounds.

This stock has a long history of exploitation by residents of Aklavik. In recent times catches have declined, indicating severe overexploitation. There was community consensus for the closure of the fishery in 1987. A study was then started to monitor the recovery and provide information on the possibility of re-opening.

Stock definition: The anadromous form spawns and overwinters in spring-fed portions of Cache Creek. In summer the feeding migration is to the coast of the Beaufort Sea, west of the Mackenzie Delta. Recent studies indicate that the stock is distinct from that of the Babbage River to the west. There is also a stream-resident charr population.

Stock size: In 1972, a Petersen estimate put the run at about 20 000 charr (95% C.I.: 15 800-27 600). This estimate came from a fishery that harvested 3 000-5 000 charr. Following this fishery, a second estimate of charr further upstream in Cache Creek gave a stock of 13 500 (95% C.I.: 11 300-16 000).

Attempts at direct assessment of the stock were made in 1987, but bad weather forced removal of the weir. Petersen estimates on the overwintering (spawning) population gave a figure of 7 600 charr (95% C.I.: 5 500-10 600), plus 1 500 non-spawners, giving a total stock of 9 100.

Vital parameters: In 1980 the modal size of the fish taken in the subsistence fishery at the mouth of the Big Fish River was 400-450 mm with a range of 250-550 mm. Modal age was 6-7 yr. In 1984 the modal length was 450-500 mm with a range of 250-700 mm. The modal age was 7 yr (5-11 yr) and the mean age 7.7 yr. Instantaneous total mortality for ages 7-11 yr was 0.65 or an annual mortality of 47%.

In 1986 the modal size was 400-499 mm, the modal age 9 yr and the mean age 8.6 yr. Most of this sample were the current year's spawners; females outnumbered males 5.2:1. Fecundity appeared to be low: 2 186 eggs/female. Big Fish River charr appear to be somewhat smaller at the same age than those of the adjacent Rat River and Firth River.

Current harvest: The area was closed to fishing in 1987.

Historically, harvests have been heavy; in 1972 an estimated 12 000 charr were removed from a population of about 27 600. This is an exploitation rate of 43%. In 1973 the catch was down to 3 700 charr.

In 1985 the harvest was estimated to be about 1 000. About half of these were taken at the mouth, the remainder in Fish Hole on Cache Creek later in the fall. In 1986, 197 were caught at the mouth and 1 660 in Fish Hole in October.

Some angling occurs but the extent is not known.

Other impacts: The Big Fish River charr spend the summer along the southern coast of the Beaufort Sea; they are thus vulnerable to oil spills should they occur in this area.

Obstructions (stream crossings, causeways, etc.) in the river pose a potential hazard to migration.

Major issues

Recovery strategy for Arctic charr in the Big Fish River: Fishing was suspended on the Big Fish River in 1987 because of apparent overexploitation. A recovery strategy must now be developed.

Assessment

Stock prognosis: If estimates are correct, it is evident that the stock has been greatly reduced since 1972. Exploitation rates of 43% in 1972 and 20% in 1986 are probably unsustainable. The most effective method for recovery is complete closure. No data from 1972 exist to determine the effect of these changes in abundance on length-frequency or age distributions. The stock is smaller and younger than the lightly exploited Firth River charr stock.

Management recommendations

1. No harvest should be allowed on the Big Fish River during 1988.
2. Stock abundance should be estimated in 1988 to determine rate of recovery. A timeframe for recovery can then be determined. Recovery probably means a return of stock abundance to 15 000-20 000 charr.
3. Once recovery has been effected, exploitation should not exceed 5% annually until sustainable exploitation rates for western Arctic charr have been determined.

Research requirements

1. The discrete identity of anadromous Arctic charr in the Big Fish River, relative to stocks in the Babbage River and Rat River, should be confirmed.
2. The abundance of anadromous Arctic charr in the Big Fish River should be estimated (possibly in 1988, no later than 1990) using mark-recapture techniques on upstream migrants (Schaefer method) or on spawning/overwintering grounds (Petersen method) to determine the rate of recovery (recruitment) of the stock. Baseline biological data on size/age structure of the stock should be gathered simultaneously with population estimates to improve understanding of the population dynamics of western Arctic charr.
3. Detailed studies of the population dynamics of western Arctic charr should be conducted to determine sustainable exploitation rates.

Next AFSAC review

February 1991.

ARCTIC CHARR IN THE HORNADAY RIVER

Background

The Hornaday River drains into the Amundsen Gulf region of the eastern Beaufort Sea, about 10 km east of the community of Paulatuk. It is within the Inuvialuit Settlement Region. Only the lower 45 km of the Hornaday River is available to anadromous charr on account of a 23 m waterfall blocking further passage upstream. Arctic charr of the eastern form have been fished for many years by residents of Paulatuk as part of the domestic fishery.

Commercial fishing began in 1968 with a quota of 2 300 kg. This was raised to 4 500 kg in 1974, and to 6 800 kg in 1976. This level of exploitation was unsustainable and catches declined in the early 1980's.

A small sport fishing lodge was established on the Hornaday in 1972, but languished after two years.

Stock definition: The Hornaday stock of Arctic charr is genetically distinct from stocks west of the Mackenzie River. In summer the anadromous charr frequent the waters of Darnley Bay, but the extent of their movement is not known. Arctic charr are known to inhabit the Brock River, 30 km to the east, but the extent of mixing of the two stocks is unknown. For the interim, it is assumed that the Hornaday River stock is discrete.

Stock size: An attempt in 1986 to enumerate stock size directly, by means of a weir, was foiled by floods in the latter part of the run. Numbers of upstream migrants increased between 9-16 August, followed by a period of fluctuation in numbers. When the weir was washed out on 28 August, numbers appeared to be on the increase. The total count was 10 789 charr up to this point. Stock size can be assumed to be somewhat in excess of this number, although it may be assumed that the run was in the terminal stages when counting ceased. The mean size of charr passing the weir appeared to be declining on 27 August, usually a sign of the approaching end of the run.

Vital parameters: Modal length of the sampled charr was 450-500 mm, with a range in size between 20?-693 mm. Mean age was 7 yr with a range of 3-11 yr. Fewer than 1% of the stock moving upstream were mature. The youngest mature charr was 8 yr old. Sex ratio was close to equality. No information is available on fecundity.

There are insufficient data to calculate mortality rates.

Current harvest: The commercial harvest from the Hornaday River since 1977 is given in Table 5. With the exception of 1982, the harvest shows a steady decline in yield after 1980. The fishery was closed in 1987. In addition to this harvest, a domestic fishery of approximately 5 000 kg is believed to take place.

Other impacts: Arctic charr remain close to the shore while feeding in the sea. Disturbances such as oil spills, causing shoreline damage along the Beaufort Sea coast, could materially affect charr during the summer.

Major issues

The decline in commercial catch has undoubtedly been compounded by a fairly extensive domestic catch, although the full extent of this is undocumented. The recovery of the stock would be assisted by a suspension of the domestic fishery, but to effect this, alternative sources of fish would have to be provided for the Paulatuk residents.

Assessment

Stock prognosis: No historical data are available on the stock size before the start of commercial fishing. However, the steady decline of the harvest since 1980 indicates overexploitation. Samples of the catch taken in 1972, 1974, 1979, 1981, 1983 and 1986 indicate a remarkable constancy in the modal size (550-600 mm) over this period of decline. The only apparent change in the length-frequency distribution is a slight decline in the number of fish over 500 mm.

There is every indication that the stock has been overexploited. A total harvest of 11 400 kg (domestic plus commercial catch) or 3 900 charr (at 2.9 kg each), from a population of 10 800 would represent an exploitation rate of 36%. Even assuming a population of 16 000 fish, it would represent an exploitation rate of 24%. For general management purposes, exploitation rates of 5% are considered sustainable.

If current stock size is 11 000-16 000 charr, 5% exploitation would give a harvest of 550-800 fish. This may equal the current level of the domestic fishery. The stock might be expected to sustain this level of harvest, but not recover.

Management recommendations

1. No commercial fishing should be allowed on the Hornaday River in 1988.
2. The extent of the current domestic harvest of Arctic charr on the Hornaday River should be determined in 1988. This should not exceed 550-800 charr annually, if stock size, estimated in 1986, is to be maintained.
3. An alternate source of Arctic charr such as the Brock River should be identified so that the domestic fishery on the Hornaday River can cease in order to allow the stock to recover.

Research requirements

1. The size of the Arctic charr stock in the Hornaday River should be determined again in 1989 using a weir and a mark-recapture estimate (Schaefer method) as a backup in the event the weir becomes inoperable. This should be done to determine whether or not recovery of the stock is taking place.
2. Once recovery of the stock has taken place, a total allowable catch should be determined and a fishing plan should be developed to ensure that subsistence and commercial harvests do not exceed the TAC.
3. If the Brock River is identified as an alternate fishing site, tagging should be done to determine whether significant mixing of stocks takes place between the Hornaday River and Brock River.

Next AFSAC review

February 1990.

ARCTIC CHARR IN THE KUUK RIVER

Background

The residents of Holman Island requested an increase in their commercial quota for sale to visitors. It was considered that the main source of charr in the neighbourhood, the Kuujjua River, could not support additional harvest. Surveys of rivers at the eastern end of Minto Inlet indicated that the Kuuk River had the greatest potential for harvest. Surveys were carried out in 1985, 1986 and 1987, although in 1986 efforts were hampered by severe ice conditions. A weir was used to evaluate the stock in 1987.

Stock definition: It is presumed that the stock on the Kuuk River is discrete, but studies are necessary to confirm this. Samples were taken for morphometric and genetic analysis. Gillnet marks on one fish indicated that it had travelled a distance of at least 40 km.

Stock size: Between 14 August and 12 September 1987, 9 204 charr migrated upstream. The run peaked on 21 August and appeared to be over by 12 September.

Vital parameters: Length ranged from 300-900 mm, with a modal length between 550-600 mm. Skewness of the distribution resulted in a mean size somewhat higher at 650 mm.

Ages ranged from 6-22 yr, with an interesting bimodal age distribution, with modes at 12-13 and 18 yr.

Instantaneous mortality for fish between 13 and 22 yr was 0.32 in 1987; in 1985 for the ages 16 to 19 yr it was 0.64, and in 1986 for the ages 14 to 18 yr it was 0.17.

First maturity was estimated at 13 yr for males and 15 yr for females.

Since most of the current year's spawners do not go to sea, there is no information on size of the spawning population or fecundity. Sex ratio was found to be 1:1 in 1986, but 2:1 in favour of females in 1985.

Current harvest: Prior to these studies the Kuuk River had not been harvested. This is corroborated by the age and length distribution of the population. In 1985, 414 kg (100 fish) were taken, 300 kg (98 fish) in 1986, and 1 850 kg (560 fish) in 1987.

Occasionally, Inuit from Holman Island net charr on the spawning grounds of this stock, in Tahiryuak Lake, in October. Fresh gillnet marks on one upstream migrant indicate that the stock is exploited to some extent in other fisheries.

Other impacts: None identified.

Major issues

None identified.

Assessment

Stock prognosis: The abundance of large, old charr indicates that there is some potential for exploitation; however, the small size of the stock indicates that this is limited. Given that the annual exploitation rate should not exceed 5% of the stock, an annual quota would be 1 700 kg (450 charr).

Management recommendations

1. An annual TAC for the Kuuk River should be set at 450 charr (1 700 kg).
2. If economical, a weir should be used for harvesting.

Research requirements

1. Estimates of fecundity and maturity should be obtained from the spawning stock.
2. Genetic analysis of samples should be undertaken.
3. Advantage should be taken of the fact that this is an unexploited stock to determine the effects of exploitation on the eastern form of Arctic charr.

Next AFSAC review

February 1991.

ARCTIC CHARR IN FRESHWATER CREEK

Background

Freshwater Creek is a short stream 4 km in length, connecting Greiner Lake with the ocean at Cambridge Bay. Until the early 1960's, it supported a considerable charr run. Recreational fishing and commercial fishing greatly reduced the size of the population in subsequent years. The stock has remained in a poor condition (low numbers and small size of individuals) since the mid-1960's. A concerted effort on the part of the local residents and DFO is needed to rehabilitate the charr run.

Stock definition: The stock is believed to be largely discrete. Tagging studies indicate 85% recovery in the same area over a five-year period. A 15% recovery in other locations indicates some straying. No information on the fidelity of spawners to their natal streams is available, but it is probably high. Summer distribution in the ocean is believed to be within 50-60 km of Cambridge Bay.

Stock size: Enumeration by means of a weir in 1982 indicated a stock of 9 962. The run started on 19 August, peaked on 26 August (3 003 charr) and was over by 7 September.

Vital parameters: Modal length was 550-600 mm, and modal age 12 yr; size ranged from 200 to 765 mm and age from 6 to 18 yr. The youngest mature males were 10 yr and youngest mature females 12 yr. The smallest mature males were 450-500 mm and smallest mature females 500-550 mm.

Instantaneous mortality calculated from the age distribution for 12-15 yr was 1.50 (78% annual mortality) in 1982.

Current harvest: A creel census in 1983 indicated an angling harvest of 778 charr. This, added to an estimated domestic catch of 994 charr, gives a total catch of 1 772. Given the total stock of 10 000 fish, this represents an exploitation rate of 17-18%. This is considered far too high to be sustainable.

Current harvest data are not available, although domestic and recreational fisheries are reported to have declined since 1983.

Other impacts: No serious impacts identified.

Major issues

Ban on fishing: It is generally agreed that the quickest means of restoring the population is through a total ban on fishing. Implementation of such a measure has been agreed to by the community. Alternative sites for domestic fishing will be essential if this measure is to be effective.

Assessment

Stock prognosis: The direct estimate of exploitation rate in 1983, combined with the high mortality rate of 78% indicates clearly that overfishing is taking place.

By community consensus at Cambridge Bay in January 1988, it was agreed that gillnet fishing should be banned in the Cambridge Bay area. Banning recreational fishing would, however, impose undue hardship on residents, because it is almost the only form of recreation for many. A maximum of 350 fish (one per licence) might be considered.

Management recommendations

1. All gillnet fishing for Arctic charr in Freshwater Creek, Greiner Lake (and other

headwater lakes on this system) and in the Cambridge Bay area should be banned for three years, after which time the status of the stock should be re-appraised (1990).
2. A trial recreational fishery should be allowed on this system in 1988 on a catch-release basis (barbless hooks), with anglers asked to release all charr. A record of any recreational catch should be kept.

Research requirements

1. The current status of the Arctic charr stock in Freshwater Creek should be determined by enumerating the upstream migration in 1988 by means of a weir. This procedure should be repeated in 1990 or 1991 to determine the rate of recovery and thus establish a time-frame for recovery.
2. The stock identity of the anadromous Arctic charr in Freshwater Creek should be confirmed by genetic studies of spawners in relation to spawners from adjacent systems.
3. The degree of mixing of Arctic charr between systems during non-spawning years should be determined.
4. Studies should continue on the population dynamics of the eastern form of Arctic charr to better understand responses to various levels of exploitation.

Next AFSAC review

February 1989.

ARCTIC CHARR OF STEENSBY INLET

Background

The community of Igloolik has been involved in a winter fishery for Arctic charr in the Steensby Inlet region of Baffin Island for a number of years. The apparent abundance of charr in this area stimulated the idea that a commercial charr fishery might be developed to supply markets in the south. If the charr population was found to be sufficiently abundant, a fish processing and freezing plant would be essential.

To determine the feasibility of such a long-term program, a two-year pilot project was established to investigate the productive capacity of the rivers in the Steensby Inlet area.

The test fishery was designed to determine the existence, timing and strength of upstream charr runs in ten rivers in the Steensby Inlet area. In addition, an intensive biological investigation was undertaken on one stream, the Sapugaarjuk River. This involved the erection of a fish weir in 1986 to examine the stock in detail. From the data on the present condition of the charr stocks, initial quotas have been determined. The findings for the individual rivers are summarized below.

Stock definition and vital parameters:

ROWLEY RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- in 1986 fishing site was relocated downstream and out into the estuary due to access problems related to tidal fluctuations impeding access by both aircraft and boat. This relocation was not believed to have a significant stock mixing effect;
- mean daily CPUE increased significantly from 1985 to 1986 (18 to 119 fish/100 m/24 h) with relocation out into the estuary;
- run was surveyed from mid-August to early September in both years; the run peaked in mid-August in 1985 but slightly later in 1986;
- harvest of test fishery quota was good in both years (71% and 133%);
- mean fork length ranged from 672 mm (1985) to 644 mm (1986);
- modal length in both years was 650 mm;
- over 95% of the fish caught were >450 mm;
- mean age was similar in both years (18.1 yr in 1985; and 18.4 yr in 1986);
- modal age increased from 16 yr (1985) to 19 yr (1986);
- mean weight was the same in both years (3.1 kg in 1985; 3.3 kg in 1986);
- condition factor (K) value was good in both years (1.16 and 1.08);
- instantaneous total mortality (Z) = 0.35 and exploitation rate (u) = 0.16.

IKPIKITTURJUAK RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- fishing site is suitable, ice problems minimal;
- mean daily CPUE decreased significantly from 1985 to 1986 (168 to 48 fish/100 m/24 h);
- run was surveyed from mid-August to early September; the run peaked at the end of August in both years;
- harvest of test fishery quota was good in both years (109% and 138%);
- mean fork length ranged from 640 mm (1985) to 605 mm (1986);
- modal length in both years was 600 mm;
- over 85% of the fish caught were >450 mm;
- mean age was similar in both years (18.9 yr in 1985; 18.8 yr in 1986);
- modal age was 19 yr (1985);
- mean weight decreased from 3.0 kg (1985) to 2.3 kg (1986);
- K value decreased from 1.21 (1985) to 0.95 (1986);
- Z = 0.23 and u = 0.06.

COCKBURN RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- fishing site is suitable although access occasionally restricted due to rocky nature of shoreline;
- mean daily CPUE were similar between years (24-29 fish/100 m/24 h);
- run was surveyed from mid-August to early September; the run peaked at the end of August in both years;
- harvest of the test fishery quota was reasonable in both years (65% and 78%);
- mean fork length decreased from 638 mm (1985) to 589 mm (1986);
- modal length was 600 mm in both years;

- over 75% of the fish caught were >450 mm;
- mean age decreased from 19.9 yr (1985) to 17.6 yr (1986);
- modal age decreased from 20 yr (1985) to 17 yr (1986);
- mean weight decreased from 3.1 kg (1985) to 2.3 kg (1986);
- K value was 1.14 (1985) and 1.01 (1986);
- Z = 0.18 and u = 0.01.

TARSUAQ ARM RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- in 1985 and 1986 fishing site was relocated in order to accurately reflect the progress of the upstream migration run. Boat and aircraft access was somewhat restricted at low tides and by winds and rough waters, and travelling time between site and camp was unfavorably high;
- mean daily CPUE averaged 28-32 fish/100 m/24 h, indicating little change with site relocation;
- run was surveyed from mid-August to early September in both years; peaks were noted in early September in both years;
- harvest of test fishery quota was only 59% in 1985 but increased to 116% in 1986 with site relocation;
- mean fork length decreased from 601 mm (1985) to 586 mm (1986);
- modal length was 600 mm in both years;
- over 75% of the fish caught were >450 mm;
- mean age decreased from 17.8 yr (1985) to 16.3 yr (1986);
- modal age increased from 17 yr (1985) to 19 yr (1986);
- mean weight was 2.5 kg (1985) and 2.3 kg (1986);
- K value was good in both years (1.12 and 1.01);
- Z = 0.46 and u = 0.25.

HARDER RIVER: - History of domestic fishing only; quantities harvested unknown;

- available fishing sites minimal; distance from site to camp necessitates excessive travelling time;
- mean daily CPUE decreased from 17 to 4 fish/100 m/24 h (1985 to 1986);
- run was surveyed from mid-August to early September in 1985 and from later part of August to early September in 1986;
- harvest of test fishery quota was poor in both years (45% and 11%);
- mean fork length decreased from 602 mm (1985) to 559 mm (1986);
- modal length was 600 mm in both years;
- over 75% of the fish caught were >450 mm;
- mean age was similar in both years (16.2 yr in 1985; 16.0 yr in 1986);
- modal age was 16 yr in both years;
- mean weight decreased from 2.5 kg (1985) to 1.3 kg (1986);
- K values were >1.00 in both years;
- Z = 0.55 and u = 0.32.

RAVN RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- fishing site is suitable; strong winds and rough water may cause some problems;
- mean daily CPUE were similar between years (58 to 55 fish/100 m/24 h);
- run was surveyed from mid-August to early September; peaks occurred at the end of August (1985) and beginning of September (1986);
- harvest of test fishery quota was good (117% and 155%);
- mean fork length was 628 mm (1985) and 638 mm (1986);
- modal length was 600 mm in both years;
- over 90% of the fish caught were >450 mm;
- mean age was similar in both years (19.1 yr in 1985; 17.7 yr in 1986);
- modal age was 19 yr in both years;
- mean weight was similar (3.2 kg in 1985; 3.0 kg in 1986);
- K values were >1.0 in both years;
- Z = 0.31 and u = 0.13.

NEERGAARD RIVER: - History of domestic fishing only; quantities harvested unknown;

- in 1986 fishing site was relocated upstream due to inaccessibility at the mouth of the river in 1985; new site is reasonable but problems may result due to shallow and rocky shorelines;
- mean daily CPUE was 40 fish/100 m/24 h in 1985; no fish were caught at the new site in 1986;
- in 1985 the run was surveyed from mid-August to early September; the peak occurred at the end of August;
- harvest of test fishery quota ranged from 74% (1985) to 0% (1986);
- mean fork length was 632 mm;
- modal length was 600 mm;
- over 95% of the fish caught were >450 mm;
- mean age was 18.3 yr;
- modal age was 16 yr in 1985 and 20 yr in 1986;
- mean weight was 3.1 kg;
- K value was good at 1.18;
- Z = 0.26 and u = 0.09.

SAPUGAARJUK RIVER: - History of domestic fishing only; quantities harvested unknown;

- fishing site was good but in 1986 problems encountered with ice due to late spring breakup; minimal fishing in 1985 due to lack of effort by fishermen;
- mean daily CPUE was 8 fish/100 m/24 h;
- run was surveyed from mid-August to early September; peak occurred late August;
- harvest of test fishery quota was poor in both years (4% and 13%);
- mean fork length was 625 mm (1986);
- modal length was 650 mm (1986);
- over 85% of the fish caught were >450 mm (1986);
- mean age was 14.5 yr (sample size = 17 for 1986);
- modal age was 17 yr (sample size = 17 for 1986);
- mean weight was 2.8 kg (1986);
- K value was good at 1.04 (1986);
- Z and u not calculated due to small sample size (n = 17).

ISORTOG RIVER: - History of both commercial and domestic fishing; quantities harvested unknown;

- fishing sites were excellent; minimal tidal effect and good access for boat and plane;
- mean daily CPUE decreased from 1985 to 1986 (54 to 30 fish/100 m/24 h);
- run was surveyed from mid-August to early September in both years; peak occurred in late August in 1986 one week later than in 1985;
- harvest of test fishery quota was good in both years (100% and 95%);
- mean fork length was 628 mm in both years;
- modal length increased from 600 mm (1985) to 650 mm (1986);
- over 90% of the fish caught were >450 mm;
- mean age increased from 16.8 yr (1985) to 18.4 yr (1986);
- modal age increased from 16 yr (1985) to 19 yr (1986);
- mean weight decreased from 3.0 kg (1985) to 2.6 kg (1986);
- K values decreased from 1.16 (1985) to 0.99 (1986);
- Z = 0.37 and u = 0.18;
- fish weir was in operation from 11 August to 6 September 1986, but only 184 fish were counted upstream.

QULURNILIK RIVER: - History of domestic fishing only; quantities harvested unknown;

- fishing site was not good; problems due to wind, tide and drifting ice and rocky shoreline made access by boat and plane difficult;
- mean daily CPUE increased significantly from 1985 to 1986 (139 to 575 fish/100 m/24 h);
- run was surveyed from mid-August to early September in both years; peak occurred late August;
- harvest of test fishery quota was excellent in both years (126% and 123%);
- mean fork length was the same for both years (681 mm in 1985; 682 mm in 1986);
- modal length was 650 mm for both years;
- over 90% of the fish caught were >450 mm;
- mean age was the same for both years (19.8 yr in 1985; 20.0 yr in 1986);
- modal age decreased from 20 yr (1985) to 18 yr (1986);
- mean weight was the same for both years (3.6 kg in 1985; 3.6 kg in 1986);
- K values were >1.00 for both years;
- Z = 0.22 and u = 0.05;
- a small tagging experiment indicated that fish passage over the falls near the river mouth was impossible; therefore there is no fish run up the river and the fish caught must be part of another stock(s).

Assessment and recommendations

The quotas recommended are reference level catches, that is they are the best figures that can be given with the data available. Changes will therefore be recommended (either increased or decreased as appropriate) in accordance with the ability of the fishery to meet the catch levels and the resulting effect on stocks' vital statistics.

The Subcommittee stresses the tentative nature of these recommendations, given the inherent difficulties involved in estimating annual production (from which quotas are derived) from data collected at point locations over a two-year period. Careful collection of harvest data over many years will establish the full potential of these streams. Over the course of this period it may be necessary to make occasional adjustments to the quotas (either up or down) as indicated by the accumulating results.

Studies on charr populations conducted in the Central Arctic suggest that the maximum exploitation should not exceed 10% of the stock (sea-run component). The safest approach for developing fisheries is to recommend exploitation at 5% until further information on stock status becomes available. In many rivers it has not been possible to assess stock sizes; instead it has been necessary to work on a strictly comparative basis, basing quotas on known yields of streams of apparently similar size. Modal age of the charr of Steensby Inlet, it should be noted, is extremely high (16 - 20 years), even relative to other charr stocks. This indicates a very slow growth and a very long replacement time, or recovery time if the population is depleted.

The difficulties in making a full assessment of the present status of the stocks are compounded by the lack of available data on the domestic harvest. Without information on this vital component, it is impossible to make any realistic evaluation of current population trends.

Rowley River: There appears to be a fall upstream migration of charr into the Rowley River. Samples from the catch indicate an abundance of large, mature fish. It is believed that shifting the fishing site out into the estuary did not lead to a high degree of stock mixing; however, this should be verified, possibly through a tagging study. The present exploitation rate indicates that the stock cannot withstand much additional fishing pressure and without further data on the size of the charr population, the catch should not exceed a 5% rate of harvest. The present quota is 4 500 kg but it is recommended that the quota be increased to only 5 000 kg as a conservative measure because there may be an undetermined, occasional subsistence harvest.

The fishing site was judged to be suitable in most respects. However, there is concern that in some years it may be vulnerable to drifting ice.

Ikpikitturjuak River: There appears to be a fall upstream migration of charr into the Ikpikitturjuak River. Samples from the test fishery catch indicate a relative abundance of large marketable fish, although in some years they may be less robust (K=0.95 in 1986). The present rate of exploitation indicates that the stock can sustain a moderate fishery. Without further data on the size of the charr population, the catch should not exceed the 5% rate of harvest.

The present quota is 1 100 kg; however, it is recommended that the quota be increased initially to 2 500 kg. The stock should be carefully watched. The river and its watershed are relatively small, which may indicate a small population. In recent years, there has been a domestic harvest.

The fishing site was judged to be suitable in most respects. However, there is concern that in some years it may be vulnerable to tides and drifting ice.

Cockburn River: It appears that the Cockburn River has a relative abundance of large robust fish although the percent of smaller fish varied between years. The present rate of exploitation indicates that the stock can sustain additional fishing pressure. The present quota is 1 100 kg. It is recommended that the quota be increased to 5 000 kg. However, as there may be an undetermined domestic harvest, the commercial quota should not exceed this amount.

The fishing site was judged to be suitable in most respects.

Tarsuaq Arm River: There appears to be no upstream migration of charr into any of the small streams examined in 1985 draining into the Tarsuaq Arm. It is believed that Tarsuaq Arm itself serves as an overwintering body for anadromous charr. The 1986 fishery was located just below the last narrows in the channel leading into Steensby Inlet. It appears that in the arm there is a reasonable abundance of large robust fish. The present rate of exploitation indicates that the stock cannot withstand much additional fishing pressure. The present quota is 1 800 kg, but it is recommended that the quota be increased only to 2 500 kg, as there is evidence of an undetermined domestic harvest.

The fishing site was judged to be suitable in most respects although there were problems with tides, winds and rough waters, as well as long travelling time between fishing sites and the camps.

Harder River: There appears to be only a very small upstream migration run of charr into the Harder River, as witnessed by the poor overall production. Samples from the catch indicate the presence of few and small-sized fish. The exploitation rate indicates that the stock cannot sustain additional fishing pressure since there may be an undetermined domestic harvest. It is therefore recommended that no commercial fishing should take place without further data as to the actual size of the charr population utilizing the river.

The fishing site was judged to be fair. Available fishing sites were few, and the distance between the site and camp necessitated extensive travelling time.

Ravn River: It appears that there is a fall upstream migration of charr into the Ravn River. Samples from the catch indicate an abundance of large, robust fish. The present exploitation rate indicates that the stock should not be subjected to much additional fishing pressure at this time. The stock has supported a domestic fishery as well as a sporadic commercial fishery. The present quota is 9 100 kg and it is recommended that this quota not be changed without further data on the size of the charr population.

The fishing site was judged to be fair, however, there is a concern that strong winds and rough water may cause problems for aircraft access.

Neergaard River: It appears from the upstream fishing site in 1986 that there is no upstream migration of anadromous charr into the Neergaard River. Therefore, it is recommended that no commercial fishing take place. Further study into the definitive presence or absence of an upstream run would be required before considering the establishment of a commercial quota.

The fishing site was judged to be fair. Problems may be encountered upstream due to shallow rocky shorelines. Sites near the mouth of the river proved to be inaccessible.

Sapugaarjuk River: It appears that the charr run into the Sapugaarjuk River may not be large enough to support a commercial fishery. Production in both years was very poor; low production in 1985 was at least partially due to the low fishing effort. It is possible that the charr run was missed in 1986 since several local people stated that this run is always the earliest. However, it seems doubtful that the upstream run would have been nearly completed by 11 August, when the survey commenced, while most of the other runs in the area peaked at the end of August or in early September. In addition, biological information is scarce; only a small number of samples was collected in 1986. Therefore, it is recommended that no commercial fishing take place. Further study of the upstream migrating charr run is required before considering the establishment of a commercial quota.

Isortog River: It appears that there is a fall upstream migration of charr into the Isortog River. Samples from the catch indicate a reasonable abundance of large, mature charr. The present rate of exploitation indicates that the stock should not be subjected to much additional fishing pressure. The present quota is 2 300 kg, but it is recommended that the quota be increased to a maximum 5 000 kg since there may be an undetermined domestic harvest.

The fishing site was judged to be suitable in most respects with minimal tidal effects and good access for aircraft and boat.

Qulurnilik River: It appears that there is no upstream migration of anadromous charr into the Qulurnilik River. Falls located approximately 1 km upstream from the river mouth preclude fish movement beyond that point. The river up to the falls is believed to be too turbulent to allow fish to utilize it for spawning or overwintering. It is therefore believed that the fish harvested near the mouth of the river are part of another charr stock(s) from the

area. It is recommended that no commercial fishing take place. Further study of stock size and origin would be required before considering the establishment of a commercial quota.

Management recommendations

1. The following information should be collected annually for the ten Steensby Inlet charr stocks:
   a. annual domestic harvest at each location;
   b. representative biological samples from each location (length, age, weight, sex of approximately 1-5% of catch);
   c. measurement of total upstream run by means of a weir (counting fence) wherever and whenever practical.
2. Careful application of the results obtained in this monitoring process to the adjustment of quotas should ensure the maximum return over future years. Great care must be exercised to avoid attempting to make charr production meet the financial needs and constraints of a commercial operation. Any commercial operation must be tailored to the productive capacity of the stocks available. Attempts to hasten the process are likely to have deleterious effects on the ultimate capacity to produce.

COMMERCIAL QUOTAS FOR ANADROMOUS ARCTIC CHARR

Background

Table 6 summarizes the 1987/88 quotas and production for anadromous Arctic charr fisheries for various water bodies in the NWT, and recommends quotas for 1988/89.

Management recommendations

1. The proposed 1988/89 quotas for the commercial fisheries for Arctic charr in the NWT (Table 6) should be adopted.

Next AFSAC review

January 1989.

REPORT OF THE AFSAC MARINE MAMMALS SUBCOMMITTEE: 1986/87

The AFSAC Marine Mammals Subcommittee provides scientific reviews on the biological status of various marine mammal stocks and makes recommendations on 1) safe and sustainable levels of harvest, and 2) requirements for research.

Membership of the Subcommittee for 1986/87 was:

R. Moshenko	(P&FF, Central and Arctic Region) Chairperson
P. Brodie	(Science, Scotia-Fundy Region)
M. Kingsley	(Science, Central and Arctic Region)
A. Mansfield	(Science, Quebec Region)
P. Richard	(P&FF, Central and Arctic Region)
R. Stewart	(Science, Central and Arctic Region)

The following background documents were presented and discussed at the AFSAC meeting on 21-22 January 1987, and reviewed by the Subcommittee.

Status of Narwhal, Monodon monoceros, in Canada. J.T. Strong. (AFSAC Document 86/87-13)

Status of Walrus (Odobenus rosmarus rosmarus) in Canada. P.R. Richard. (AFSAC Document 86/87-12)

Status of Sub-Arctic Beluga (Delphinapterus leucas) Populations in the Northwest Territories and Northern Quebec. P.R. Richard. (AFSAC Document 86/87-11)

Successful management of marine mammals in the Canadian Arctic requires thorough knowledge of stock identity, the range of each stock, and the inter-relationships among stocks. The knowledge to identify all stocks of marine mammals does not exist; thus the Subcommittee chose to continue using the International Whaling Commission (IWC) definition of "management stock" implying "a population unit most conveniently managed". The Subcommittee defined, reviewed and recommended on management and research of four stocks:

High Arctic Narwhal;
Sub-Arctic Walrus;
Western Hudson Bay Beluga;
Southeast Baffin Beluga.

The reviews are summarized in the following format: a stock's life history, stock size and utilization were reviewed. A stock prognosis is provided, indicating a stable, declining or increasing status. Most importantly, recommendations are provided for sustainable levels of the harvest, and for research to fill those data gaps vital to refining management of stocks. A section on "other impacts" is provided; these were not discussed at the AFSAC general meeting. In several cases, bracketed comments are given to indicate existence of more current data than were presented in the background documents.

In general, surveys of Arctic marine mammal stocks must continue to enable trends in distribution and abundance to be determined. Research on vital parameters also must continue since very few parameters are understood on a stock-specific, or even a species-specific basis. It is most important that all harvests of stocks be monitored, on an ongoing basis, for biological parameters and for statistics of landed catches and hunting losses.

HIGH ARCTIC NARWHAL

Background

Stock definition: The high Arctic narwhal stock occurs during summer in deep fiords and adjacent waters of Baffin Island and Somerset Island, with known concentrations in Eclipse Sound, Admiralty Inlet, Prince Regent Inlet and Peel Sound. The link between this stock and narwhal summering in western Greenland and

northwestern Hudson Bay is undefined, but they are thought to winter together. Until this relationship is disproved, the Canadian high Arctic stock is considered to be distinct.

Stock size: The stock is estimated to number 23 700 (95% C.I.=18 100-29 500) narwhal. This estimate is uncorrected for animals submerged at time of survey.

Vital parameters: Female narwhal reach sexual maturity at six years of age and calve on average every three years. Annual birth rate is estimated at 7% or an average of 1 659 (95% C.I. = 1 267-2 065) young. Natural mortality rates are unknown.

Current harvest: The total quota for this stock is 487 and the mean annual landed catch is 284. The proportion of narwhal killed but lost during hunts ranges between 24-43% (mean 32%), depending on the type of hunt. The total removal is thus estimated at 1.32-1.75 (mean 1.47) times the landed catch, or a mean of 417 (375-497).

Other impacts: No serious impacts are identified but potential threats include chemical pollutants.

Major issues

Vessel transport: Potential disturbance to narwhal may be caused by shipping in the Eastern Arctic.

Chemical pollutants: Accumulation of pollutants (heavy metals, PCBs, etc.) may occur in narwhal tissues.

Assessment

Stock prognosis: Total removal is 417 narwhal or 22.5-30% (mean 25%) of the mean annual number of births. There is no indication that the stock is declining. Thus, the stock apparently can sustain the current level of harvest.

Management recommendations

1. Total allowable catch (landed) should not exceed the current quota of 487. Community quotas were negotiated between DFO and the local Hunters and Trappers Associations (HTA) during the 1970's. The basis for these negotiations was the best available scientific information on the stock and the stated "needs" by the local communities.

Research requirements

1. Considerable data already exist on diving behaviour. These should be analyzed and reported for input to improving survey estimates by correcting for submerged animals.
2. Stock definition requires improvement to clarify the relationship between these animals and narwhal summering in northwestern Hudson Bay and western Greenland.
3. Improved estimates of loss rates are required to determine total removal. Hunting losses should be continually monitored.
4. Data on vital parameters are currently inadequate. Most estimates are extrapolated from other species, and need to be derived for narwhal specifically.

Next AFSAC review

The next review is recommended after the 1983-1985 survey results are published. Therefore, it should be done in January 1989.

SUB-ARCTIC WALRUS

Background

Stock definition: The Sub-Arctic walrus stock consists of those walrus residing in Hudson Bay, Foxe Basin, Hudson Strait and Davis Strait.

Stock size: Based on dated (1977 and earlier) and partial haul-out counts, a minimum of 7 000 walrus has been indicated. Systematic surveys have not been carried out to estimate the size of the stock.

Vital parameters: Females reach sexual maturity at about 6-7 yr and calve once every three years on average. Annual birth rate is estimated as 8-11%. Natural mortality rates are unknown.

Current harvest: Mean annual landed catch is estimated at 501 walrus. An estimated 20-30% of animals killed are not retrieved. The total removal is therefore estimated to be 1.25-1.43 times the landed catch, or 626-716 walrus.

Other impacts: No serious impacts are identified but potential threats include chemical and acoustic pollutants and human encroachment on traditional haul-out sites. Competition for food may become a problem with the development of commercial marine fisheries.

Major issues

Stock size: Comprehensive surveys are needed to determine stock size.

Quotas: Effective regulatory control of harvest is needed.

Assessment

Stock prognosis: The total removal of animals approximates the minimum gross production before natural mortality (8%-11% of 7 000 = 560-770). Unless population size is substantially larger than the minimum estimate, it is probable that the stock is declining. The most optimistic expectation is that the population is presently harvested at a sustainable rate.

Management recommendations

1. Pending review of new information, harvest should be held at the current level. TAC (landed) should not exceed 501 walrus.

Research requirements

1. Population size should be re-estimated after completion of surveys commencing in 1988.
2. Stock definition, in terms of possible exchange between Foxe Basin, Hudson Bay, Hudson Strait and Davis Strait should be clarified.
3. Population estimates in general should be improved by more complete and comprehensive (behaviourally corrected) surveys.
4. To support item 3, behavioural studies are required of haul-out, population segregation, site fidelity and migration.
5. Stock-specific data on vital parameters are required.
6. To assess total removal, improved statistics on landed catch and hunting losses are required on an annual basis.

Next AFSAC review

A review should take place in January 1989, if new data are available from the 1988 survey.

WESTERN HUDSON BAY BELUGA

Background

Stock definition: The western Hudson Bay beluga stock is concentrated during summer along the coast and in the estuaries of western Hudson Bay. The relationship of these animals to the beluga in eastern Hudson Bay, northern Hudson Bay, Hudson Strait and Ungava Bay is unclear.

Stock size: The population is estimated to number between 7 000-11 000 animals. [Note: preliminary results of the 1987 surveys indicate more beluga eastward to James Bay and farther offshore than previously reported].

Vital parameters: Female beluga attain sexual maturity at five years of age and calve every three years on average. Net annual replacement rate has been estimated at 5%, indicating an annual production of 350-550 young. However, the replacement estimate is suspected of being too high. Natural mortality rates are unknown.

Current harvest: On average, 236 beluga are landed annually in western Hudson Bay (Eskimo Point, Churchill, Whale Cove and Rankin Inlet = 115/yr) and northern Hudson Bay (Chesterfield Inlet, Coral Harbour and Repulse Bay = 121/yr). In the latter area, a relatively small population (500-1 000) is found in summer, but there are strong indications that a large proportion of the northern Hudson Bay catch comes from the western Hudson Bay stock. Loss rate has been estimated for other stocks at 8-30%, but the upper limit of this range is considered high for western/northern Hudson Bay. Using a range of loss rates of 8-20%, the western/northern Hudson Bay annual removal is estimated to be 1.09-1.25 times the landed catch, or 257-295 beluga. The western Hudson Bay stock is probably hunted in Hudson Strait where catches average 329 beluga per year but the proportion of that harvest which belongs to this stock is unknown.

Other impacts: No serious impacts are identified. Potential threats include chemical and acoustic pollutants, and hydroelectric power development.

Major issues

Hydroelectric power development: Potential disturbances resulting from hydroelectric power developments may take place in estuaries (especially Nelson River and Churchill River estuaries).

Quotas: Effective regulatory control of harvest is needed.

Assessment

Stock prognosis: Based on present estimates of stock size, if only the western and northern Hudson Bay catch are taken into account, this stock may be able to increase, albeit slowly. If the Hudson Strait catch is included, the stock at best would be stable, but possibly declining.

Management recommendations

1. TAC (landed) in western and northern Hudson Bay combined should not exceed 236 beluga per year.

Research requirements

1. Data from the 1987 survey should be analyzed and reported. These data have the potential to substantially alter current estimates of stock size and discreteness.
2. Stock definition and migratory patterns need investigation to determine if, when and where these beluga are hunted outside western and northern Hudson Bay. This information is required so that estimates of additional removal by hunting in other areas can be made.
3. Stock-specific vital parameters need to be derived.
4. Estimates of hunting losses are required, since hunting conditions and techniques in Hudson Bay are different from those in other areas.

Next AFSAC review

The next review is recommended for January 1989, when results from the 1987 survey will be available.

SOUTHEAST BAFFIN BELUGA

Background

Stock definition: The southeast Baffin beluga stock concentrates in Cumberland Sound from late July to October and includes animals present in the Frobisher Bay area. It probably also includes animals found in the Lake Harbour area during fall, winter and spring. The relationship of this stock to the beluga in Ungava Bay and Hudson Bay is unknown.

Stock size: The population size is estimated at 500-600 beluga.

Vital parameters: Female beluga reach sexual maturity at age five years and calve every three years on average. Annual birth rate is estimated at 7%. Net annual replacement rate is thought to be less than 5%, about 25 to 30 animals. Natural mortality is unknown.

Current harvest: Since 1980, a regulated quota of 40 beluga per year has restricted the landed catch in Cumberland Sound where residents of Pangnirtung hunt. The mean reported landed catch in Pangnirtung and Frobisher Bay between 1980-1985 has been 70 beluga per year. During these hunts, an estimated 8-30% of the beluga killed are lost. The total annual removal is therefore estimated at 1.09-1.43 times the landed catch, or 76-100 beluga. In the same years, an average of 11 beluga per year were harvested at Lake Harbour. The proportion of this harvest which comes from the southeast Baffin stock is unknown.

Other impacts: No serious impact identified. Potential threats include chemical and acoustic pollutants.

Major issues

Threatened stock: Continued harvesting threatens the survival of the stock.

Assessment

Stock prognosis: Because of the small size of this population, the current level of harvest cannot be sustained. Any harvest at such a low population level, combined with repeated low production years could lead to the loss of this stock.

Management recommendations

1. It is desirable that there should be no hunt of the southeast Baffin beluga stock to enable it to recover as quickly as possible to a size at which the present rate of removal could be safely resumed.
2. If there must be a hunt, the total removal (landed plus lost) from the stock must not exceed 15 beluga (3% of the stock), and it is preferable that the removal should be fewer than 15 to ensure an adequate safety margin for recovery.

Research requirements

1. Data from the 1985 and 1986 surveys should be analyzed and utilized to provide the most current estimate of stock size.
2. Stock delineation continues to be a major problem. It is important to determine whether these beluga are exposed to hunting in Lake Harbour and other communities. This is required to calculate total removal from the stock.
3. The harvest requires continued monitoring (catch, size, sex, etc.) to assess the effects of altered management.

Next AFSAC review

The next review is recommended for January 1989, when survey data from 1985 and 1986 should be available.

REPORT OF THE AFSAC MARINE MAMMALS SUBCOMMITTEE: 1987/88

The AFSAC Marine Mammals Subcommittee provides scientific reviews on the biological status of various marine mammal stocks and makes recommendations on 1) safe and sustainable levels of harvest, and 2) required research.

Membership of the Subcommittee for 1987/88 was:

R. Moshenko (P&FF, Central and Arctic Region) Chairperson
M. Kingsley (Science, Central and Arctic Region)
P. Richard (P&FF, Central and Arctic Region)
T. Smith (Science, Quebec Region)
R. Stewart (Science, Central and Arctic Region)

The following background documents were presented and discussed at the AFSAC meeting on 28-29 January 1988, and reviewed by the Subcommittee.

Status Report: Beaufort Sea Beluga. J.T. Strong. (AFSAC Document 87/88-13)
Northern Hudson Bay Narwhal Stock. P.R. Richard. (AFSAC Document 87/88-14)
Status of the Ringed Seal in Canada. M.C.S. Kingsley. (AFSAC Document 87/88-15)
Current Status of the Bering Sea Stock of Bowhead Whales. E. Mitchell and R.R. Reeves. 1986. Musk-Ox 34: 57-76.

The Subcommittee defined, reviewed and made recommendations on management and research for three stocks:

Eastern Beaufort Sea Beluga;
Northern Hudson Bay Narwhal;
Ringed Seals, with special emphasis on the Cumberland Sound and Home Bay areas.

The Subcommittee concluded that the background document for the western stock of bowhead whales was inadequate to address management and research requirements. The Subcommittee, therefore, recommended the preparation of a background document using the approved format for the January 1989 review.

EASTERN BEAUFORT SEA BELUGA

Background

Stock definition: The stock summers in an area bounded by Amundsen Gulf, the Yukon/Alaska border, the coast of Canada and an undefined offshore boundary related to polar ice pack distribution. Beluga are also found beyond this

line and into the pack ice, but the relationship between offshore and coastal beluga is not clear. The stock is thought to be a part of a larger population found in the Bering, western Beaufort, Chukchi and Siberian seas.

Stock size: The size of the eastern Beaufort Sea stock has been estimated variously at 3 500, 7 000, 11 500, and 17 700 animals. The lowest estimate, based on a survey of only part of the summering area, was rejected. The two higher estimates include offshore surveys and may include beluga from a different stock. The best estimate of stock size was considered to be 7 000, and subsequent calculations were based on this figure.

Vital parameters: There are no data for this stock. Extrapolating from other studies provides:

- gross annual reproduction rate (GARR) of 7.7%;
- lactation period of two years;
- age of female maturity at six years.

Using GARR of 7.7% and a stock size estimate of 7 000 indicates about 540 calves are produced per year. Natural mortality rates are unknown.

Current harvest: The estimated landed catch is 125 beluga per year with a loss rate of 17.7%, based on recent but unpublished data. The background document recommended rounding the loss rate to 20%; this figure was used in subsequent calculations. Total removal in the Canadian Beaufort Sea was thus estimated at 156 animals per year. When these whales migrate west along the Alaskan coast in August, they are hunted again resulting in a further estimated removal of 120. The total removal from the stock is therefore about 276 (156+120) beluga each summer.

Other impacts: A number of other potential impacts were identified including continued hydrocarbon development, hydroelectric power development on the Mackenzie River or its tributaries, port development and commercial fishing of marine and anadromous species. The impact of these developments was not evaluated, but they are considered to be important (see Recommendations).

Major issues

Northern development: Disruption of beluga habitat through industrial and fishery development are concerns that need clarification and research (see Recommendations).

Assessment

Stock prognosis: Annual total removal of 276 beluga is 51% of estimated annual calf production (540) and 3.9% of the total population (7 000). There are insufficient data to assess whether this rate of exploitation has altered stock size, but work in progress suggests a 2-3% mean finite rate of increase at present.

Management recommendations

1. Total allowable removal should be no greater than 3.9% or 276 beluga, subject to revision pending the completion of reproductive rate modelling studies which indicate that removal rates should be no more than 2-3%. This recommendation is based on the absence of data to indicate changes in stock size at this current rate of removal. Current estimates indicate that about 56% (156 of 276) of this removal would be in Canada and 44% in Alaska.
2. TAC in Canadian waters should not exceed 125 beluga per year, subject to revision pending the completion of data analysis of population size and hunting loss.

Research requirements

1. Current analysis of stock size and hunting loss rates should be completed and the results made available to AFSAC.
2. Current modelling of recruitment rates in exploited beluga populations should be completed. Current samples and data from the Mackenzie estuary area should be analyzed to produce site-specific estimates of reproduction rates. The results of both should be made available to AFSAC.
3. The cost of increased accuracy in estimating population size should be modelled against the risk of not detecting a declining trend under various management regimes. An opportunity exists to test this on beluga in the St. Lawrence estuary during the next two summer seasons. It is recommended that such a study be completed and published within the next two years.
4. The relationships among related stocks must be clarified. Most urgent are the definitions of onshore and offshore stocks and exchange between stocks in Alaska and Canada in the summer. A direct approach is the use of tags, but population models which examine harvest levels with respect to stock size might also indicate recruitment from other areas.
5. Potential disruptions to beluga habitat physical and biological) should be reviewed and appropriate areas studied. Research of this nature need not be site-specific, and an initial step would be to support the proposed DFO workshop (coordinated by the Quebec Region) on beluga in April 1988. One product of this workshop will be a consideration of habitat requirements for beluga.

Next AFSAC review

In the absence of unforeseen developments, the next review of the Beaufort Sea beluga stock should be after current analyses of reproduction rates, stock size and hunt losses are completed. Therefore, the next AFSAC review probably should be in January 1990.

NORTHERN HUDSON BAY NARWHAL

Background

Stock definition: Narwhal range in Hudson Bay from approximately 62°N to 67°N latitude and in summer are concentrated in the Repulse Bay/Frozen Strait area. Observations of westward spring movements near Cape Dorset suggest that narwhal winter in Hudson Strait. A narwhal aggregation of similar size to the Repulse Bay/Frozen Strait summer aggregation was located in eastern Hudson Strait during a systematic survey in March 1986. A gap in distribution separates the Baffin Bay/Davis Strait winter aggregation from that in eastern Hudson Strait. Until it is shown that exchange with other stocks takes place, the northern Hudson Bay stock will be assumed to be a geographically separate stock.

Stock size: Stock size was estimated from surveys of the summer aggregations. A 90% probability level is used to derive confidence limits since there is a positive correlation in the numbers of animals in the adjacent transects in these surveys. The variance tends to be overestimated and a 95% probability level would give unnecessarily conservative limits. Stock size is thus estimated to number 1 400 (90% C.I.: 1 000-1 900).

Vital parameters: Reproductive parameters of this stock have not been studied but are assumed to be similar to those of the high Arctic stock where females reach sexual maturity at six years of age and calve on average every three years. Because of the similarity of narwhal and beluga reproductive parameters, it is assumed that they have similar replacement rates. Preliminary modelling of population parameters suggests that rate of increase in an exploited beluga population is probably near 0.02-0.03 of the total population size. Therefore, the estimated annual sustainable yield of this northern Hudson Bay stock is to be 2% of 1 400 animals or a net annual production of 28 narwhal.

Current harvest: The harvest of narwhal in Hudson Bay is limited to a few Keewatin communities which are listed below in order of the importance of their harvest. An average of 20 narwhal are taken each year in this harvest.

Community	Mean annual catch 1978-1986	Quota
Repulse Bay	18.7	25
Rankin Inlet	0.8	10
Coral Harbour	0.7	10
Whale Cove	0.1	5
Chesterfield Inlet	0.0	5
Total	20.3	55

The proportion of narwhal killed but lost during these hunts is unknown. To estimate the total annual removal of northern Hudson Bay narwhal it was assumed that total losses are equivalent to those of mean high Arctic (32%), therefore total annual removal is estimated to be 1.47 times the landed catch (20), or 29 narwhal.

Other impacts: There are presently no industrial development projects such as those found elsewhere in the Arctic. Therefore, oil spills or ship noise are not likely to pose a threat to narwhal in northern Hudson Bay in the near future.

Major issues

Vital parameters: The lack of estimates of vital rates based on biological data is a major problem in managing this species. To estimate total allowable catch, information from related species, such as the beluga, is relied upon, but may not be applicable.

Current quotas: Quotas were set by negotiating community needs and are not based on biological data. The sum of the Keewatin community quotas exceeds by more than twofold the above mean annual catch. This could be a problem in future management.

Assessment

Stock prognosis: Total mean annual removal (landed plus lost) of 29 is similar to the annual sustainable yield (28) and represents 2.1% of the total population size estimate. There is no scientific information on past stock sizes to assess population trends. The current level of harvest or catch is comparable to that experienced by the high Arctic stock which shows no sign of decline after continued harvesting for decades (see 1986/87 review of the high Arctic narwhal). Thus, the northern Hudson Bay stock may be able to sustain the current level of harvest, but its small size and the imprecision in estimates used for these calculations are cause for concern.

Management recommendations

1. Total allowable annual catch (landed) should not exceed 20 narwhal. This assumes that removal (landed plus lost) is 28 narwhal or fewer.
2. Subject to confirmation and completion of beluga population models and publishing of narwhal replacement rates, community quotas should be adjusted downwards so their total does not exceed 20 narwhal.

Research requirements

1. Data on vital parameters of narwhal are currently inadequate. Estimates need to be derived specifically for narwhal. Work initiated on reproduction and aging should be supported and published. Then, models, such as the ones developed for beluga, should be developed to derive new estimates directly from narwhal biological parameters.
2. The cost of increased accuracy in estimating population size should be modelled against the risk of not detecting a declining trend under various management regimes. It is recommended that such a study be completed and published within the next two years.
3. Considerable data exist already on narwhal diving behaviour. These should be analyzed and used to improve survey estimates by correcting for submerged animals.

4. The relationship between this stock and narwhal summering in the high Arctic and western Greenland needs to be clarified. Studies involving mark-recapture, radiotelemetry, biochemical genetics and organic pollutant profiles should be continued or undertaken.

Next AFSAC review

A review should be carried out only after the results of research (recommendations 1-3 above) have been published.

RINGED SEALS

Background

Stock definition: This stock presently is considered to include all ringed seals in the Canadian Arctic, since there is no basis for identifying more than one separate stock of ringed seals.

Stock size: There are no good data on the total number of ringed seals in the stock. Some areas of the Canadian Arctic have been carefully surveyed using defined methods; others have not. The estimated energetic requirement of the Canadian stock of polar bears, which are the chief predators of ringed seals, indicates that the standing stock of ringed seals should be in the order of 3 000 000 animals. Survey estimates of visible seals cover most Canadian Arctic waters except the central mainland coast and the main inter-island channels south of Parry Channel. The total estimated number of seals visible to aerial survey in the surveyed waters is in the order of 1 000 000. Studies have also shown that 40-80% of seals are visible during surveys. Based on previous studies, landfast and pack ice surface areas and approximate density estimates of 1 seal/km^2 in Cumberland Sound and 0.5 seal/km^2 on offshore ice, the estimated numbers of ringed seals are 80 000 for Cumberland Sound and 70 000 for Home Bay (Davis Strait area).

Vital parameters: The average age of first reproduction is approximately 7.5 years. Pregnancy rates from the age of ten years on are 90%. Early mortality is estimated at 16-41% for pups and 12-13% for subadults. Adult mortality is about 10-11%/yr and seals older than 20 yr are rare in samples. An approximate exploitation rate has been estimated at 8%.

Current harvest: There are no good statistics on the current harvest of ringed seals. The harvest is somewhere in the range of 10 000-100 000 per year. It has varied greatly in past decades with variation in the number of dog teams, the price of seal pelts, and the availability of other meat such as caribou and muskox. Even so, effects on the stock have not been obvious.

Other impacts: Continued heavy predation by Arctic foxes and polar bears is likely a major impact. Icebreaker traffic in breeding habitat and possible major increases in some local harvests for commercial uses are other potential impacts.

Major issues

Commercial sealing: Potential economic development funding may be available for commercial leather tanning (e.g. for the Cumberland Sound area) prior to good stock assessment studies.

Assessment

Stock prognosis: The stock is stable, but there is, from time-to-time, evidence of recurrent mortality due to high population densities and large-scale fluctuations in reproductive rates due to unidentified factors.

Management recommendations

1. Total allowable annual catch (landed) based on an approximate exploitation rate of 8% should be as follows:

   Cumberland Sound area - not to exceed 6 400 seals;
   Home Bay area - not to exceed 5 600 seals.

Research requirements

1. Immediate baseline data should be obtained for areas in which heavy local commercial harvests are proposed.
2. Age, size and maturity structure should be monitored in commercial harvests.
3. Studies of distribution and movement should be directed to determine whether there are areas in which production exceeds mortality and vice versa. The studies should work toward defining such areas and establishing the mechanisms of transfer. Methods would be used to define the structure and growth rate of populations in breeding habitat and in supposed subadult dispersal areas, and to trace local movements or long-distance migration by satellite tagging. Population dynamics in breeding areas can be studied using known techniques. Movements can be studied using satellite radios, and perhaps by chemical or radioactive tracers; this is practicable but expensive, and it would take a long time to gather useful data. Population dynamics and rates of predation and other causes of mortality in subadult dispersal areas would be very difficult or impossible to study as these are thought to be areas of unconsolidated ice.
4. Continued study of behaviour is required to relate true numbers to densities estimated by aerial survey.
5. Ecosystem studies at lower and higher trophic levels should be carried out to estimate densities of ringed seals in terms of the available primary and secondary production, and the requirements of the known predators.
6. Ecosystem studies are also required at the same trophic level to define the relationships between ringed seals and other pinnipeds and cetaceans.

7. Studies of diving behaviour and feeding are needed to clarify feeding energetics and time budgets.

Next AFSAC review

The next AFSAC review should be in January 1990 after two seasons of field surveys and estimates of harvests, especially in the Cumberland Sound area.

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Table 1. The numbers of situations for which scientific advice is required by fishery category and by type of advice.

CATEGORY / Species	Domestic Fisheries *	I	II	III	IV	V	Commercial Fisheries *	I	II	III	IV	V	Sport Fisheries *	I	II	III	IV	V
ANADROMOUS FISH																		
Arctic charr		6	4	15	10	5		11	99	8	17	3		2	3	6	17	3
Coregonids			9		3	1			1		2							
Brook trout																		
TOTAL		6	13	15	13	6		11	100	8	19	3		2	3	6	17	4
FRESHWATER FISH																		
Lake trout					27			5			14			2	1	3	36	6
Coregonids		59						6		4	44							
Inconnu					1			1	2								2	
Grayling				3							1					6	22	
Walleye								1		1	1			2			6	
Northern pike				3	30						1			1	6			
Other				3	30													
TOTAL		59		9	88			13	2	5	61			5	7	9	66	6
MARINE FISH																		
Cod					3						3							
Turbot									4									
Shrimp									3									
Scallop									3									
P. Herring					1							1						
Other					7						5	6						
TOTAL					11				10		8	7						
ALL FISH		65	13	24	112	6		24	112	13	88	10		7	10	15	83	10
MARINE MAMMALS																		
Beluga			6															
Narwhal			2															
Bowhead			2															
Walrus			3			1												
Ringed seal					>7							3						
Bearded seal					3													
Harp seal			1															
ALL MAR MAMMALS			14		>10	1						3						

* Advice types:

I Advice required annually; knowledge base generally adequate
II Advice required annually; knowledge base inadequate
III Advice required periodically; knowledge base generally adequate
IV Advice required intermittently; scientific input minimal
V Advice requested; scientific input not yet available

Blank spaces signify no present requirements for advice or no situations

Table 2. Schedule proposed in 1986 for AFSAC reviews for 1986/87 to 1989/90 and preparation of background documents.

YEAR	FISH SUBCOMMITTEE		MARINE MAMMALS SUBCOMMITTEE	
	Report Title	Author	Report Title	Author
GENERAL REPORTS				
1986/87	Information needs for effective fishery management			R. Moshenko
	Oceanographic research in relation to Arctic fisheries research			L. Johnson
	Exploitation of Arctic fish stocks	R. Crawford	Arctic marine mammal research plan	R. Stewart
	Identification of Arctic fish stocks	J. Reist		
STOCK REPORTS				
1986/87	Arctic charr: all stocks except those of the Inuvialuit Settlement Region	A. Kristofferson with E. Gyselman, L. Johnson and G. Low	Beluga: Hudson Bay, Hudson Strait, Ungava Bay and southeast Baffin	P. Richard, T. Smith and R. Stewart
	Walleye: Hay R., Kakisa L., Mosquito Creek and Tathlina L.	M. Roberge with J. Craig and G. Low	Narwhal: general	T. Strong
	Great Bear L.: lake trout preliminary review	M. Roberge	Walrus: general	P. Richard
1987/88	Inuvialuit Settlement Region: Arctic charr	A. Kristofferson with B. Bond	Beluga: western Arctic	T. Strong
	Coregonids	J. Reist with B. Bond and K. Chang-Kue	Bowhead: western Arctic	E. Mitchell
			Narwhal: northern Hudson Bay	P. Richard

...2/

Table 2. (cont'd)

YEAR	FISH SUBCOMMITTEE		MARINE MAMMALS SUBCOMMITTEE	
	Report Title	Author	Report Title	Author
	Arctic charr: Freshwater Creek	A. Kristofferson	Ringed Seal: general	M. Kingsley and T. Smith
	Arctic charr in NWT (changes & summary)	A. Kristofferson		
	Lake trout: Great Bear L. (including 1984/85 data)	M. Roberge		
	Walleye: Mosquito Creek	M. Roberge		
1988/89	Igloolik area	M. Roberge	Narwhal: Lancaster Sound area	S. Cosens, M. Kingsley, M. Roberge and T. Strong
	Arctic charr in NWT (changes & summary)	A. Kristofferson		
	Pacific herring	A. Kristofferson with M. Lawrence	Ringed Seal: specific areas	M. Kingsley
	Grayling: Kakisa R.	M. Roberge	Beluga: Lancaster Sound area	R. Stewart
	Keewatin Inland lakes	L. Johnson	Bowhead: eastern Arctic	E. Mitchell
1989/90	Great Slave Lake area: Chitty L. study	L. Johnson with E. Gyselman	Walrus: Foxe Basin, Hudson Bay, Hudson Strait	P. Richard and T. Smith

...3/

Table 2. (cont'd)

YEAR	FISH SUBCOMMITTEE		MARINE MAMMALS SUBCOMMITTEE	
	Report Title	Author	Report Title	Author
	Arctic charr in NWT (changes & summary)	A. Kristofferson		
	Inconnu	R. Moshenko		
	Lake trout	M. Roberge and G. Yaremchuk		
	Lake whitefish	J. Clayton and M. Roberge		
FUTURE YEARS	Arctic charr in NWT (changes & summary)	A. Kristofferson		
	Other species: Burbot Arctic grayling Greenland halibut etc.			

Table 3. Creel census summary for walleye from Mosquito Creek, 1973-1986.

Year	Number of Angler Days	Estimated Harvest of Walleye		% Retained	Total Hours Fished	Number of Walleye Caught	
		Caught	Kept			per Angler	per Angler Hour
1973	105	572	541	95	251	5.4	2.3
1974	149	365	339	93	501	2.4	0.7
1975	173	282	255	90	547	1.6	0.5
1976	288	522	514	99	843	1.8	0.6
1977	295	385	385	100	747	1.3	0.5
1978	269	354	336	95	599	1.3	0.6
1983	803	1 298	1 190	92	2 528	1.6	0.5
1986	879	2 928	2 049	70	2 847	3.3	1.0

Table 4. 1986/87 quotas and production and 1987/88 recommended quotas for the anadromous Arctic charr commercial fisheries in the Northwest Territories. Regions and designations of water bodies follow those of Schedule V, Northwest Territories Fishery Regulations. Quotas and production figures are in kilograms round weight. Quotas in brackets are equivalent dressed weight. NA = not available at present, NF = not fished.

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
REGION IV - CENTRAL ARCTIC				
Agnew River Area	4 500	NA	4 500	Apparently this system has not been fished at all for a number of years.
Arrowsmith River	1 000	160	1 000	System overfished in past. Closed in 1982. Nominal quota of 1 000 kg in 1986. Fishing reported to be poor. Status of stock unknown.
Becher River	2 000	227	2 000	Has been overfished in past. Sampled in 1985. Stock not recovered yet.
Coppermine River	600	600	600	Substantial domestic fishery exists here. Also supports recreational fishery. Recommend quota remain at 600 kg. Sampled in 1986, data not yet realized.
Curtis River	not opened		4 500	No data from this system. Actual harvest should be documented.
Ekalluk River	14 500	14 349	14 500 (11 600)	This fishery concentrates on what is believed to be the largest charr stock in the Cambridge Bay area. Upstream count exceeded 183 000 in 1979. Stock identity being investigated using biochemical techniques. Stock monitored in 1986. Data not yet analyzed. Mortality has increased gradually but steadily since 1978. Quota was taken with no

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Ekalluk River cont'd				difficulty. Tag returns from tagging program in Wellington Bay suggest this stock also exploited by fisheries at Paliryuak, Halovik and Lauchlan rivers. Based on tag returns the actual harvest could exceed 34 000 kg. This represents exploitation near 10%. Recommend quota remains at 14 500 kg if present fishing patterns persist and stock be monitored annually.
Ellice River	4 500	4 180	4 500 (3 600)	This stock is believed to be discrete from mainland stocks, based on tagging data. Sampled in 1984, size declined possibly in response to increased production. Quota reduced to 4 500 kg. Monitored in 1986. Data not yet analyzed.
Halovik River	6 800	6 830	6 800 (5 440)	This may or may not be a discrete stock. If it is, it is relatively small. The upstream count was 21 000 in 1981. Tagging data suggest exploitation is about 5%. The bulk of this fishery is probably supported by the Ekalluk River stock. Actual harvest could be around 3 200 kg. Recommend quota remain at 6 800 kg and fishery be monitored annually. Stock identity should be confirmed using biochemical and/or morphometric techniques.
Jayco River	13 600	13 515	13 600 (10 880)	This stock is believed to be discrete from the other

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Jayco River cont'd				island stocks and is the second largest stock exploited by the Cambridge Bay fishery. Upstream count exceeded 139 000 in 1981. Present exploitation is probably around 4%. Although fishery is not in jeopardy it is recommended that the quota remain at 13 600 kg and that this stock be monitored annually.
Keith Bay	4 500	726	4 500	Fished lightly in past few years. Sampled in 1985. Stock stable. Recommend quota remain at 4 500 kg.
Kellett River	1 000	1 000	nil	Sampling in 1979 and 1980, indicated stock over-exploited. Annual domestic fishery of approximately 1 800 kg. Sample in 1985 showed stock had not recovered. Recommend closure of commercial fishery for 1987.
Kulgayuk River	not opened		nil	Existence of stock uncertain.
Lauchlan River	9 100	8 243	9 100 (7 280)	According to tag returns this could be a discrete stock; if it is, it is very small. The upstream count in 1983 totalled only 11 000 charr. Wellington Bay tagging program suggests most charr taken in this fishery overwinter in Ekalluk River. Actual harvest could be about 4 200 kg. This represents exploitation of close to 13%. Stock identification must be comfirmed and could result in a decrease in the

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Lauchlan River cont'd				quota and changes to present fishing strategies. Until such time the quota can remain at 9 100 kg. The fishery must be monitored annually.
Lord Lindsay Lake	3 000	NA	3 000 (2 590)	Listed as landlocked; it should be sea-run. Additional domestic harvest of about 1 100 kg. No problems reported.
Murchison River	9 100	NA	9 100 (7 840)	Fishing reported to be good.
Norway Bay	not opened		4 500	None.
Paliryuak River	9 100	9 123	9 100 (7 280)	There may be no actual upstream run of charr in this system. Tagging results indicate most charr taken in this system overwinter in Ekalluk River. Recommend quota remain at 9 100 kg and stock be monitored annually.
Perry River	not opened		4 500 (3 600)	Not fished since 1981. Previously showed signs of overfishing. A sample of the catch should be taken in 1987 to determine whether stock is recovering.
Port Parry	2 300	10	2 300	Commercial fishery reported to be very poor due to low CPUE. Could be a problem. Should be sampled in 1987.
Simpson River	4 500	NF	4 500	Little is known of this stock.
Stanwell-Fletcher Lake	6 800	NA	6 800	Estimated additional domestic harvest of 1 000 kg.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Thomsen River	not opened		1 400	Little is known of this stock.
Unnamed River East of Ellice	not opened		nil	Existence of stock uncertain.
Unnamed River Dease Pt.	not opened		nil	Existence of stock uncertain.
Unnamed River & Lake	not opened		900	None.
Unnamed River Cape Adelaide	not opened		4 500 (3 600)	None.
Unnamed River Collinson Peninsula	not opened		4 500 (3 600)	None.
REGION V - KEEWATIN				
Alden Lake & River	not opened		900	None.
Baker Foreland Area	2 300	2 524	2 300	Sampled in 1986. Data not yet analyzed.
Belcher Islands	not opened		nil	People of Belcher Islands do not wish to fish commercially.
Bennett Bay Wager Bay	2 300	NA	2 300	None.
Big River Barbour Bay	not opened		900	None.
Brown River	6 800	NA	6 800	None.
Chesterfield Inlet Fish Bay	2 300	2 566	2 300	Should be sampled in 1987. May be a need for tagging in this area to determine stock identity.
Churchill River Area	500	NA	500	None.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Christie Lake	not opened		900	None.
Cleveland River Area	7 600 summer 1 500 winter	NF NA	7 600 summer 1 500 winter	A test fishery was planned for 1986 but was cancelled due to logistic problems.
Copperneedle River	4 500	NA	4 500	None.
Corbett Inlet	4 500	305	4 500	Effort low. Some concern about small size of fish. Sampled in 1986. Data not yet analyzed.
Diana Lake	not opened		nil	Overwintering area for Diana River stock which has been over-exploited. No quota recommended.
East Point	not opened		4 500	None.
Eskimo Point	4 500	5 129 (combined with Maguse River)	4 500	Sampled 1986. Could not distinguish between charr taken here and at Maguse River due to close proximity of fisheries. Problem of stock identity. Data not yet analyzed.
Ferguson River	13 600	28	13 600	Production was down due to low effort.
Gibson Cove	not opened		2 300	None.
Gordon River	not opened		1 100	None.
Gore Bay	3 600	NA	3 600	Apparently poor production due to lack of interest.
Hanway River	not opened		2 300	None.
Haviland Bay	2 300	NA	2 300	None.
Josephine Bay	4 500	292	4 500	Production low due to lack of interest.
Kamarvik Creek	not opened		2 300	None.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Maguse River	4 500	5 129 (combined with Eskimo Point)	4 500	Sampled in 1986. Problem with stock identity with Eskimo Point due to proximity of fisheries.
Merle Harbour	2 300	540	2 300	Test fished in 1986. Data not yet analyzed.
Mistake Bay	2 300	186	2 300	Problem with stock identity.
North Pole River	not opened		2 300	None.
Peter Lake	not opened		nil	Diana River stock overwinters here. Recommend no fishery.
Piksimak River	not opened		2 300	None.
Pistol Bay	2 300	2 300	2 300	Sampled 1986. Data not yet analyzed.
Ranger Seal Bay	not opened		9 100	Not fished recently.
Rankin Inlet	not opened		nil	This fishery was closed in 1985 due to overexploitation. Residents of Rankin Inlet agreed to reduce the domestic harvest. The angling limit was reduced from 4 and 7 to 2 and 4. The stock was assessed using a fish weir on the upstream migration in 1986. Numbers and size were both down compared with historic levels. A recovery strategy is being formulated. Recommend commercial fishery remain closed.
Robin Hood Bay	6 800	235	6 800	Not known if poor production is due to lack of effort or lack of fish.
Sandy Point	900	NA	900	Stock here is believed to be small.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Snowbank River	not opened		2 300	None.
Steep Bank Bay	4 500	1 108	4 500	Test fished in 1986. Data not yet analyzed.
Stoney Point Area	6 800	2 723	6 800	None.
Thomsen River	2 300	nil	2 300	Test fishery and assessment using weir failed as weir was inundated by high tide.
Wallace River	2 300	NA	2 300	None.
Whale Cove Area	not opened		nil	Combined with Wilson Bay.
Wilson Bay	7 000 summer 3 000 winter	4 554	7 000 summer 3 000 winter	Combined with Whale Cove as suspect only one stock. Sampled 1986. Data not yet analyzed.
Unnamed River	not opened		2 300	None.
Unnamed River	not opened		2 300	None.
Unnamed River	not opened		6 800	None.
Unnamed River	not opened		6 800	None.
Unnamed River Wager Bay	not opened		2 300	None.
REGION VI - BAFFIN - HIGH ARCTIC				
Adams Island Lake & River	not opened		700	None.
Amadjuak Lake	9 100	NA	9 100	None.
Blandford Bay	900	115	900	Fishing ongoing at time of report.
Cape Adair Lake & River	2 300	NA	2 300	None.
Clyde Inlet	2 300	NA	2 300	None.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Cockburn River	1 100	791	1 100	Test fished for second year in 1986. Data not yet analyzed.
Coutts Inlet	not opened		900	None.
Drewry River Lake Gillian	3 200	NA	3 200	None.
Duart Lake & River	not opened		700	None.
Eque Bay Area	900	NA	900	None.
Feachem Bay Lake & River	not opened		900	None.
Freshwater Lake	4 500	5 101	4 500	Fishing assumed good.
Gifford River	3 600	NA	3 600	None.
Hall Lake	3 600	NA	3 600	None.
Ikaluit River Tay Sound	2 300	2 273	2 300	Fishing assumed good.
Ikalojuak	not opened		nil	Residents of Pangnirtung request this fishery remain closed.
Irvine Inlet	4 500	564	4 500	None.
Isortog River	2 300	1 457	2 300	Test fishery for second year in 1986. Data not yet analyzed.
Kingnait Fjord	4 500	486	4 500	Recreational fishery here as well. Should be sampled in near future.
Kipisa Lake	1 400	1 049	1 400	None.
Kukaluk River	3 600	NA	3 600	None.
Lethbridge Lake & River	not opened		1 400	None.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Nedlukseak Fjord	not opened		3 600	None.
Newton Fjord Area	not opened		2 300	None.
Nettilling Lake	not opened		22 700	Not fished due to lack of interest.
Nudlung Fjord	4 500	NA	4 500	None.
Okalik Bay	900	NA	900	None.
Padle River	3 600	NA	3 600	None.
Padle Fjord	3 600	NA	3 600	None.
Padloping Island	900	NA	900	None.
Paquet Bay River & Lake	1 000	NA	1 000	Some concern over small size of fish. Quota reduced from 2 300 to 1 000 in 1985.
Phillips Creek	not opened		nil	No interest in fishing.
Piling Lake & River	1 800	NA	1 800	None.
Qualluatik Lake	700	NA	700	None.
Ravn River	1 500 test 6 500	2 404 NA	9 100	Test fished for second year in 1986. Data not yet analyzed. Production data for winter fishery not available yet.
Rowley River	4 500	2 002	4 500	Production shown was taken in second year of test fishery, 1986. Data not yet analyzed.
Sam Ford Fjord	3 600	816	3 600	Small domestic fishery (450 kg).
Saputing River	9 100	NA	9 100	None.

Table 4. (cont'd)

Waters	1986/87 Quota	1986/87 Production	1987/88 Recommended Quota	Comments
Tarsuaq Arm River and Lake	1 800	1 115	1 800	Production shown was taken in second year of test fishery, 1986. Data not yet analyzed.
Tasialojuak Lake	not opened		nil	No interest in fishing.
Tugat River	1 000	574	1 000	Concern about small size of fish. Quota reduced to 1 000 kg in 1985.
Whyte Lake & River	900	NA	900	None.
Unnamed river (God's Mercie)	not opened		900	None.
Unnamed Fjord (Cumberland Sd)	1 400	904	1 400	None.
Unnamed River (Kekertelung Is.)	not opened		2 300	None.
Unnamed River	1 400	NA	1 400	Fishing reported poor in past. Should be sampled in near future.
Unnamed Lake & River (Dexterity Fjord)	not opened		900	None.
Unnamed Lake & River (Dexterity Fjord)	not opened		500	None.
Unnamed River & Lake (Kentra Bay)	not opened		500	None.
Unnamed Lake & River (Styrmann Is.)	not opened		900	None.
Unnamed River & Lake	1 100	NA	1 100	None.

Table 5. Commercial harvest of Arctic charr from the Hornaday River between 1977 and 1986.

Year	Production (kg round weight)
1977	6 341
1978	6 023
1979	6 795
1980	6 427
1981	2 721
1982	9 072
1983	3 400
1984	5 300
1985	2 764
1986	2 402*

* estimated

Table 6. 1987/88 quotas and production and 1988/89 recommended quotas for the anadromous Arctic charr commercial fisheries in the Northwest Territories. Regions and designations of water bodies follow those of Schedule V, Northwest Territories Fishery Regulations. Quotas and production figures are in kilograms round weight. Quotas in brackets are equivalent dressed weight. NA = not available at present, NF = not fished.

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
REGION IV - CENTRAL ARCTIC				
Agnew River Area	4 500	NA	4 500	Apparently this system has not been fished at all for a number of years.
Arrowsmith River	1 000	276	1 000	System overfished in past. Closed in 1982. Nominal quota of 1 000 kg in 1986 and 1987. Fishing reported to be poor. Status of stock unknown.
Becher River	1 000	771	1 000	Has been overfished in past. Quota reduced from 2 000 in 1986 to 1 000 in 1987.
Coppermine River	600	520	600	Substantial domestic fishery exists here. Also supports recreational fishery. Recommend quota remain at 600 kg.
Curtis River	not opened	1 700	4 500	No data from this system.
Ekalluk River	14 500	14 661	14 500 (11 600)	This fishery concentrates on what is believed to be the largest charr stock in the Cambridge Bay area. Upstream count exceeded 183 000 in 1979. Stock identity being investigated using biochemical techniques. Stock monitored in 1987. Size and age structure appears constant. Quota was taken with no difficulty. Tag returns from tagging program in Wellington Bay suggest this stock also exploited by

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Ekalluk River cont'd				fisheries at Paliryuak, Halovik and Lauchlan rivers. Based on tag returns the actual harvest could exceed 34 000 kg. This represents exploitation near 10%. Recommend quota remain at 14 500 kg if present fishing patterns persist and stock can be monitored annually.
Ellice River	4 500	4 525	6000 (4800)	This stock is believed to be discrete from mainland stocks, based on tagging data. Sampled in 1984, size declined possibly in response to increased production. Quota reduced to 4 500 kg. Since then size and age have shown an increase. Modal age increased from 8 yr in 1984 to 11 yr in 1987. Recommend quota be increased to 6 000 kg for 1988.
Halovik River	6 800	6 829	6 800 (5 500)	This may or may not be a discrete stock. If it is, it is relatively small. The upstream count was 21 000 in 1981. Tagging data suggest exploitation is about 5%. The bulk of this fishery is probably supported by the Ekalluk River stock. Actual harvest could be around 3 200 kg. Recommend quota remain at 6 800 kg and fishery be monitored annually. Stock identity should be confirmed using biochemical and/or morphometric techniques.
Jayco River	13 600	13 686	13 600 (10 900)	This stock is believed to be discrete from the other

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Jayco River cont'd				island stocks and is the second-largest stock exploited by the Cambridge Bay fishery. Upstream count exceeded 139 000 in 1981. Present exploitation is probably around 4%. Although fishery is not in jeopardy it is recommended that the quota remain at 13 600 kg and that this stock be monitored annually.
Keith Bay	4 500	252	4 500	Fished lightly in past few years. Sampled in 1985. Stock stable. Recommend quota remain at 4 500 kg.
Kellett River	1 000	1 000	1 000	Sampling in 1979 and 1980 indicated stock over-exploited. Annual domestic fishery of approximately 1 800 kg. Sample in 1985 showed stock had not recovered.
Kulgayuk River	not opened		nil	Existence of stock uncertain.
Lauchlan River	9 100	9 508	9 100 (7 300)	According to tag returns this could be a discrete stock; if it is, it is very small. The upstream count in 1983 totalled only 11 000 charr. Wellington Bay tagging program suggests most charr taken in this fishery overwinter in Ekalluk River, hence the disproportionate quota in relation to the stock size. Actual annual harvest could be about 4 200 kg. This represents exploitation of close to 13%. Stock identification must be confirmed and could result in a

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Lauchlan River cont'd				decrease in the quota and changes to present fishing strategies. Until such time the quota can remain at 9 100 kg. The fishery must be monitored annually.
Lord Lindsay Lake	3 000	1 188	3 000 (2 600)	Listed as landlocked, it should be sea-run. Additional domestic harvest of about 1 100 kg. No problems reported.
Murchison River	9 100	NF	9 100 (7 900)	Apparently not fished.
Norway Bay	not opened		4 500	None.
Paliryuak River	9 100	8 735	9 100 (7 300)	There may be no actual upstream run of charr in this system. Tagging results indicate most charr taken in this system overwinter in Ekalluk River. Recommend quota remain at 9 100 kg and stock be monitored annually.
Perry River	not opened		4 500 (3 600)	Not fished since 1981. Previously showed signs of overfishing. A sample of the catch should be taken in 1988 to determine whether stock is recovering.
Port Parry	2 300	1.5	2 300	Commercial fishery reported to be very poor due to low CPUE. Should be sampled in 1988.
Simpson River	4 500	NF	4 500	Little is known of this stock.
Stanwell-Fletcher Lake	6 800	NA	6 800	Estimated additional domestic harvest of 1 000 kg.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Thomsen River	not opened		1 400	Little is known of this stock.
Unnamed River East of Ellice	not opened		nil	Existence of stock uncertain.
Unnamed River Dease Pt.	not opened		nil	Existence of stock uncertain.
Unnamed River & Lake	not opened		900	None.
Unnamed River Cape Adelaide	not opened		4 500 (3 600)	None.
Unnamed River Collinson Peninsula	not opened		4 500 (3 600)	None.
REGION V - KEEWATIN				
Alden Lake & River	not opened		900	None.
Baker Foreland Area	4 600	1 655	4 600	Origin of stock unknown (possibly Josephine River). Sampled 1979, 1986, 1987 modal size constant, modal age decreased from 11 yr to 9 yr. Fishermen agreed not to fish Josephine River if half the quota added to Baker Foreland. This was done in 1987.
Belcher Islands	not opened		nil	Some recent interest in commercial fishing. No plans yet.
Bennett Bay Wager Bay	not opened		2 300	None.
Big River Barbour Bay	not opened		900	None.
Brown River	not opened		6 800	None.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Chesterfield Inlet Fish Bay	4 600	3 000	4 600	May be a need for tagging in this area to determine stock identity. Similar to Baker Foreland, half the Josephine River quota added to this area in 1987. Sampled 1987. Size similar to Baker Foreland, but modal age 10 yr.
Churchill River Area	500	NA	500	None.
Christie Lake	not opened		900	None.
Cleveland River Area	7 600 summer 1 500 winter	NA NA	7 600 summer 1 500 winter	No production figures available yet.
Copperneedle River	4 500	330	4 500	None.
Corbett Inlet	4 500	2 200	4 500	Quota not taken by Oct. 31/87. Extension to March 31/88. Last sampled in 1986. Modal size 550-600 mm modal age 8 yr. Production figures not final. Winter fishing in progress.
Diana Lake	not opened		nil	Overwintering area for Diana River stock which has been overexploited. No quota recommended.
East Point	not opened		4 500	None.
Eskimo Point	4 500	10 400 (combined with Maguse River)	4 500	Sampled 1986. Modal size 550-600 mm, modal age 9 yr. Fishery comprised of only 3 year classes. Could not distinguish between charr taken here and at Maguse River due to close proximity of fisheries. Problem of stock identity. Production is combined Eskimo Point-Maguse R.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Ferguson River	13 600	5 100	13 600	Production was down due to lower effort. Weir was unsuccessful.
Gibson Cove	not opened		2 300	None.
Gordon River	not opened		1 100	None.
Gore Bay	3 600	80	3 600	Apparently poor production due to lack of interest.
Hanway River	not opened		2 300	None.
Haviland Bay	2 300	64	2 300	None.
Josephine River	4 500	NF	4 500	Fishermen from Rankin and Chesterfield requested that this quota be split and half assigned to Baker Foreland and half to Chesterfield Inlet. Therefore, no fishing here.
Kamarvik Creek	not opened		2 300	None.
Maguse River	4 500	10 400 (combined with Eskimo Point)	4 500	Last sampled in 1986. Problem with stock identity with Eskimo Point due to proximity of fisheries.
Merle Harbour	2 300	NA	2 300	Last sampled in 1986. Stock appeared to be in good condition.
Mistake Bay	2 300	400	2 300	Problem with stock identity.
North Pole River	not opened		2 300	None.
Peter Lake	not opened		nil	Diana River stock overwinters here. Recommend no fishery.
Piksimak River	not opened		2 300	None.
Pistol Bay	2 300	2 064	2 300	Last sampled 1986. Stock appeared stable. Modal size 550-600 mm. Modal age 9 yr. Fishery comprised of only 3 year classes.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Ranger Seal Bay	9 100	NA	9 100	No production figures.
Rankin Inlet	not opened		nil	This fishery was closed in 1985 due to overexploitation. Residents of Rankin Inlet agreed to reduce the domestic harvest. The angling limit was reduced from 4 and 7 to 2 and 4. The stock was assessed using a fish weir on the upstream migration in 1986. Numbers and size were both down compared with historic levels. A recovery strategy is in effect. Recommend commercial fishery remain closed. Test samples (139 mm mesh gill net) taken in 1985, 1986, and 1987. Modal size up to 550-600 mm in 1986 & 1987 from 500-550 mm in 1985. Modal age up to 9 yr in 1986 & 1987 from 8 yr in 1985. DFO to investigate establishing minimum gillnet mesh size for domestic fishery at 139 mm and to ban all gillnetting on downstream run. Harvest statistics for recreational and domestic fisheries must be kept.
Robin Hood Bay	6 800	NA	6 800	Suspect interest in this fishery is low.
Sandy Point	900	NA	900	Stock is believed to be small.
Snowbank River	not opened		2 300	None.
Steep Bank Bay	4 500	700	4 500	Last sampled in 1986. Modal size 550-600 mm, modal age 9 yr.
Stoney Point Area	6 800	1 900	6 800	None.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Thomsen River	2 300	2 300	4 200	Test fishery and assessment using weir in 1987 indicated run of 15 500 charr. Stock appeared to be lightly exploited. Recommend TAC of 4 200 kg (10%).
Wallace River	2 300	NA	2 300	None.
Whale Cove Area	not opened		nil	Combined with Wilson Bay.
Wilson Bay	7 000 summer 3 000 winter	5 000 NA	7 000 summer 3 000 winter	Combined with Whale Cove as suspect only one stock. Last sampled 1986. Modal size 550-600 mm, modal age 9 yr.
Unnamed River	not opened		2 300	None.
Unnamed River	not opened		2 300	None.
Unnamed River	not opened		6 800	None.
Unnamed River	not opened		6 800	None.
Unnamed River Wager Bay	not opened		2 300	None.
REGION VI - BAFFIN - HIGH ARCTIC				
Adams Island Lake & River	not opened		700	None.
Amadjuak Lake	9 100	NF	9 100	No interest in fishing.
Blandford Bay River	not opened		900	None.
Cape Adair	2 300	NF	2 300	Apparently only domestic fishing (200 kg).
Clyde Inlet	not opened		2 300	None.
Cockburn River	5 000	90	5 000	Test fished in 1985 and 1986. Recommended quota 5 000 kg.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Coutts Inlet	not opened		900	None.
Drewry River Lake Gillian	3 200	NF	3 200	No reported harvest.
Duart Lake & River	not opened		700	None.
Eque Bay Area	not opened		900	None.
Feachem Bay Lake & River	not opened		900	None.
Freshwater Lake	4 500	4 779	4 500	Fishing assumed good.
Gifford River	3 600	3 500	3 600	None.
Hall Lake	3 600	3 600	3 600	Increase requested by fishermen. Need level of domestic harvest.
Ikaluit River Tay Sound	2 300	2 000	2 300	Apparently concerns about fishery. Domestic harvest 1 800 kg. Should be sampled in 1988.
Ikalojuak Bay area	not opened		nil	Residents of Pangnirtung request this fishery remain closed.
Irvine Inlet	4 500	4 500	4 500	Some concern. Should be sampled in 1988.
Isortog River	5 000	662	5 000	Test fished in 1985 and 1986. Recommend quota of 5 000 kg.
Kingnait Fjord	4 500	1 346	4 500	Recreational fishery here as well. Should be sampled in near future.
Kipisa Lake	1 400	1 557	1 400	Fished by two communities. Should be sampled in near future.
Kukaluk River	3 600	NA	3 600	None.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Lethbridge Lake & River	not opened		1 400	None.
Nedlukseak Fjord	not opened		3 600	None.
Newton Fjord Area	not opened		2 300	None.
Nettilling Lake	not opened		22 700	Not fished due to lack of interest.
Nudlung Fjord	4 500	NA	4 500	No reported harvest yet. Some fishing may still take place.
Okalik Bay	900	900	900	None.
Padle River	3 600	NA	3 600	No reported harvest yet. Some fishing may still take place.
Padle Fjord	3 600	NF	3 600	Apparently not fished.
Padloping Island	not opened		900	None.
Paquet Bay River & Lake	1 000	1 136	1 000	Some concern over small size of fish. Quota reduced from 2 300 kg to 1 000 kg in 1985.
Phillips Creek	not opened		nil	No interest in fishing.
Piling Lake & River	not opened		1 800	None.
Qualluatik Lake	700	700	700	None.
Ravn River	9 100	1 500	9 100	Possibly more production. Winter fishery.
Rowley River	5 000	910	5 000	Test fished in 1985 and 1986. Recommended quota 5 000 kg.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Sam Ford Fjord	3 600	3 500	3 600	Small domestic fishery (900 kg).
Saputing River	9 100	2 728	9 100	None.
Tarsuaq Arm River & Lake	2 500	507	2 500	Test fished in 1985 and 1986. Recommended quota 2 500 kg.
Tasialojuak Lake	not opened		nil	No interest in fishing.
Tugat River	1 000	1 000	1 000	Concern about small size of fish. Quota reduced to 1 000 kg in 1985. Should be sampled in 1988.
Whyte Lake & River	900	133	900	None.
Unnamed River (God's Mercie)	not opened		900	None.
Unnamed Fjord (Cumberland Sd)	1 400	1 673	1 400	None.
Unnamed River (Kekertelung Is.)	not opened		2 300	None.
Unnamed River	1 400	NA	1 400	Fishing reported poor in past. Should be sampled in near future.
Unnamed Lake & River (Dexterity Fjord)	not opened		900	None.
Unnamed Lake & River (Dexterity Fjord)	not opened		500	None.
Unnamed River & Lake (Kentra Bay)	not opened		500	None.

Table 6. (cont'd)

Waters	1987/88 Quota	1987/88 Production	1988/89 Recommended Quota	Comments
Unnamed Lake & River (Styrmann Is.)	not opened		900	None.
Unnamed River	2 500	617	2 500	Test fished in 1985 and 1986. Recommended quota 2 500 kg.

Appendix 1. Central and Arctic Region. Arctic Fisheries Scientific Advisory Committee. Terms of Reference and Operating Procedures, April 1987.

BACKGROUND

1. In May, 1986, the predecessor of the Central and Arctic Region, the Western Region established the Arctic Fisheries Scientific Advisory Committee (AFSAC). AFSAC was seen as the mechanism that would enable the Western Region to provide biologically sound advice to fisheries management boards, to demonstrate the biological soundness of its fisheries management decisions to other resource users, industry and government agencies, to assess the biological basis for these decisions and to ensure all advice is subject to peer review for its scientific quality. The availability of biologically sound advice would result in increased DFO effectiveness in consultations with clients.

   The original terms of reference and procedures were established in July, 1986 and modified in April, 1987 to reflect the departmental organization.

ROLE

2. AFSAC functions, under the direction of the Director of Biological Sciences, Central and Arctic Region, to provide sound biological advice, based on the available information, on fish and marine mammal management issues in the area for which the Region has management responsibilities for fish and marine mammal stocks. The advice is provided to the Director-General and the Director of Fisheries Operations who are responsible for the management of the stocks.

3. The objective of AFSAC is:

   > "to provide sound biological advice to Fisheries Management (the Director-General and Director of Fisheries Operations of the Central and Arctic Region) on Arctic fish and marine mammal stocks so that management decisions result in the long-term well-being of these stocks".

4. The responsibilities of AFSAC are:

   a) to assess the status of fish and marine mammal stocks and to make biologically sound recommendations on harvest levels;
   b) to assess other biological aspects of management (such as size restrictions, closed seasons, mesh size, etc.) and to make biologically sound recommendations on such operational requirements for management;
   c) to assess the adequacy of biological information available for making fisheries management decisions and to make recommendations for its extension or improvement;
   d) to review and assess biological aspects of general management plans for fish and marine mammals; and
   e) to respond to any other requests for biological advice on fisheries management and habitat issues from the Director-General, Director of Fisheries Operations, Regional Director of Science, or Director of Biological Sciences, Central and Arctic Region, as may from time to time arise.

   AFSAC, normally, will not consider non-biological aspects of management decision making such as the allocation of harvests among different groups. These decisions are made by the Director of Fisheries Operations or other appropriate agencies.

STRUCTURE AND PROCESS

5. The structure and process for AFSAC are established to:

   - be an internal DFO process for developing the best biological advice on fisheries issues;
   - be as simple as possible;
   - operate with as little bureaucracy and support as possible;
   - operate on the peer review principle;
   - include a cross-section of the scientific expertise available;
   - be separate from external consultation processes;
   - result in the publication of reports on the scientific advice provided as required;

6. AFSAC comprises a Chairperson, an Executive Committee, a Fish Subcommittee, and a Marine Mammals Subcommittee. Additional subcommittees will be formed as necessary, e.g. Fish Habitat.

7. The Chairperson provides a single focus for AFSAC and is responsible for the timely and effective operation of AFSAC, coordinating the work of the two subcommittees, publishing the annual report, and administering AFSAC.

8. The AFSAC Executive Committee assists the Chairperson in planning and conducting AFSAC activities.

9. The subcommittees conduct the peer reviews necessary for discharging AFSAC's responsibilities and develop high quality advice for Fisheries Management.

10. The sch dule of events for each year is as follows

a) the operational year will begin in April and end in March;
b) the AFSAC Executive Committee, in consultation with the Directors of Fisheries Operations and Biological Sciences, establishes in April the review priorities for the coming year and identifies staff to prepare each background paper;
c) the Chairperson, AFSAC, requests the preparation of background papers by appropriate Regional staff in consultation with other experts;
d) background papers are forwarded to the Chairperson, AFSAC, by 1 January;
e) the Chairperson, AFSAC, provides each paper to the Chairperson of the appropriate subcommittee;
f) during January each subcommittee meets, receives a presentation on each of its papers, reviews these paper and ensures that they are scientifically rigorous, and consults with the authors on any revisions required;
g) each subcommittee then prepares a summary report (two-three pages) for each topic encapsulating the background information and providing the required advice, with rationale, on harvest levels, other management requirements, the availability of biological information, timing of the next AFSAC review of the topic, etc; each revised background paper becomes an appendix to each of the subcommittee's reports;
h) the Chairperson of the subcommittee provides the subcommittee's reports and appendices to the Chairperson of AFSAC by 15 February;
i) the Chairperson of AFSAC provides the summary reports and appendices to the Director, Biological Sciences 1 March. If approved, they are then forwarded through the Regional Director, Science to the Director-General and Director of Fisheries Operations;
j) each year, the Chairperson of AFSAC assisted by the chairpersons of each subcommittee prepares an annual report consisting of a summary of AFSAC activities and its summary reports (without appendices) for publication in the Canadian Manuscript Report of Fisheries and Aquatic Sciences series; and
k) authors of background reports, revised if necessary, will be encouraged to publish them.

11. The process for responding to unscheduled requests should follow the steps and timing outlined above as closely as possible.

12. It is intended that the AFSAC system functions separately from other Central and Arctic Region science quality control activities. However, the Chairperson maintains appropriate linkages with other committees, such as Regional Science Council and the Publications Review Committee.

MEMBERSHIP ON AFSAC

13. The Chairperson of AFSAC is appointed by the Director of Biological Sciences in consultation with the Regional Director of Science, the Director-General and the Director of Fisheries Operations.

14. The AFSAC Executive Committee comprises the Chairperson of AFSAC, the subcommittee chairpersons and the Manager of the Regulatory and Native Affairs Division.

15. Membership of each subcommittee comprises:

a) a chairperson selected from appropriate Regional staff;
b) three research scientists or biologists with appropriate expertise and experience from the Central and Arctic Region, with at least one from Arctic Management Research and at least one from Fisheries Operations;
c) one appropriate expert from outside the DFO Central and Arctic Region; and
d) additional experts on specific topics being considered, and the people involved in the preparation of background papers.

16. Subcommittee chairpersons and other subcommittee members are selected by the Chairperson, AFSAC, in consultation with the Director of Biological Sciences and the Director of Fisheries Operations, Central and Arctic Region.

17. Membership on AFSAC Committees is for three years, with initial terms being staggered to ensure continuity.

Appendix 2. List of AFSAC Background Documents for 1986/87 and 1987/88.

1986/87 BACKGROUND DOCUMENTS

86/87-1 Arctic Fisheries Scientific Advisory Committee, Terms of Reference and Operating Procedures, July 1986. Position Paper on the Arctic Fisheries Scientific Advisory Committee, April 1987.

86/87-2 Studies on the Systematics and Population Structure of Arctic Marine, Anadromous, and Freshwater Fishes. A Justification and Statement of Need for Research. J.D. Reist.

86/87-3 Exploitation of Arctic Fishes. R. Crawford.

86/87-4 Limnology, Oceanography and Fisheries Research. The View from the Arctic Window. L. Johnson.

86/87-5 Status of Lake Trout in Great Bear Lake, N.W.T. G. Yaremchuk and M.M. Roberge.

86/87-6 Status of the Walleye Utilizing the Hay River, Northwest Territories. M.M. Roberge and G. Low.

86/87-7 Status of the Walleye Stock from Tathlina Lake, Northwest Territories. M.M. Roberge and G. Low.

86/87-8 Status of the Walleye Stock from Kakisa Lake, Northwest Territories. M.M. Roberge and G. Low.

86/87-9 Status of the Walleye Stock Utlizing the Mosquito Creek, Northwest Territories. M.M. Roberge and G. Low.

86/87-10 Status Report on Searun Arctic Charr Stocks in the Northwest Territories. A. Kristofferson, G. Low, L. Dahlke, E. Gyselman and L. Johnson.

86/87-11 Status of the Sub-arctic Beluga (Delphinapterus leucas) Populations in the Northwest Territories and Northern Quebec. P.R. Richard.

86/87-12 Status of Walrus (Odobenus rosmarus rosmarus) in Canada. P.R. Richard.

86/87-13 Status of the Narwhal, Monodon monoceros, in Canada. J.T. Strong.

1987/88 BACKGROUND DOCUMENTS

87/88-1 Stock Assessment for Arctic Charr in the Steensby Inlet Area, N.W.T. M.M. Roberge.

87/88-2 Interim Report on the Status of the Broad Whitefish (Coregonus nasus) Stocks of the Lower Mackenzie Basin. R.F. Baker.

87/88-3 Update on the Status of Lake Trout in Great Bear Lake, Northwest Territories. M.M. Roberge.

87/88-4 The Walleye of Mosquito Creek, Northwest Territories. M.M. Roberge.

87/88-5 Stock Status of Arctic Charr in the Firth River, Yukon Territory. A.H. Kristofferson and R.F. Baker.

87/88-6 Stock Status of Arctic Charr in the Babbage River, Yukon Territory. A.H. Kristofferson and R.F. Baker.

87/88-7 Stock Status of Arctic Charr in the Rat River, Northwest Territories. A.H. Kristofferson and R.F. Baker.

87/88-8 Stock Status of Arctic Charr in the Big Fish River, Northwest Territories. A.H. Kristofferson and R.F. Baker.

87/88-9 Stock Status of Arctic Charr in the Hornaday River, Northwest Territories. A.H. Kristofferson.

87/88-10 Stock Status of Arctic Charr in the Kuuk River, Northwest Territories. A.H. Kristofferson.

87/88-11 Stock Status of Arctic Charr in Freshwater Creek, Northwest Territories. A.H. Kristofferson, G. Carder, D.K. McGowan and G. Low.

87/88-12 Recommended Commercial Fishing Quotas in the Northwest Territories 1988/89. A. Kristofferson, L. Dahlke and G. Low.

87/88-13 Status Report: Beaufort Sea Beluga. J.T. Strong.

87/88-14 Northern Hudson Bay Narwhal Stock. P.R. Richard.

87/88-15 Status of the Ringed Seal in Canada. M.C.S. Kingsley.